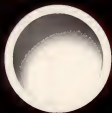


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Shipments	1000	1200	1500	1800	2000	2200	2500	2800	3000	3200	3500	3800	30000
Revenue	10000	12000	15000	18000	20000	22000	25000	28000	30000	32000	35000	38000	300000
Profit	1000	1200	1500	1800	2000	2200	2500	2800	3000	3200	3500	3800	30000
Cost	9000	10800	13500	16200	18000	20000	22500	25200	27000	29000	31500	34200	270000
Revenue	10000	12000	15000	18000	20000	22000	25000	28000	30000	32000	35000	38000	300000
Profit	1000	1200	1500	1800	2000	2200	2500	2800	3000	3200	3500	3800	30000
Cost	9000	10800	13500	16200	18000	20000	22500	25200	27000	29000	31500	34200	270000

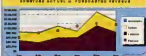


APERTURE SALES

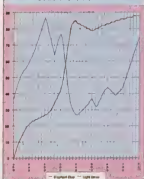
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Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Shipments	1000	1200	1500	1800	2000	2200	2500	2800	3000	3200	3500	3800	30000
Revenue	10000	12000	15000	18000	20000	22000	25000	28000	30000	32000	35000	38000	300000
Profit	1000	1200	1500	1800	2000	2200	2500	2800	3000	3200	3500	3800	30000
Cost	9000	10800	13500	16200	18000	20000	22500	25200	27000	29000	31500	34200	270000

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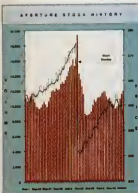


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Revenue	10000	12000	15000	18000	20000	22000	25000	28000	30000	32000	35000	38000	300000
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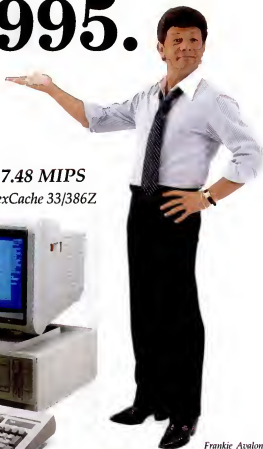
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Inside

With this issue we welcome you to **PC Magazine**, Version 3.0.

This marks the first time that the look of **PC Magazine** has changed significantly since it was completely redesigned in early 1986. That design, which marked the first time a computer magazine had been given the look of a business magazine, lasted 3½ years. It was ready for some improvements as we started to chart our course into the 1990s.

We recognize that **PC Magazine** provides a vast amount of incredibly dense information. Our challenge is to keep that information accessible. Therefore, the goal of our new look is simple: to continue to provide hundreds of information-packed pages in each issue, but to present the articles and product evaluations in a cleaner, clearer way.

To that end, we've reordered the table of contents so it lists all the magazine's departments in the order in which they appear, packed even more information into our benchmark-test charts, added some welcome white space to the pages, and turned the After Hours section around so it runs front to back instead of back to front. Also, by popular demand, we've made the page numbers easier to read. (Watch out for boxes labeled F.Y.I. throughout this issue; they alert you to some of the changes.) We've arrived at a layout that is far more flexible than



the old one; it can easily accommodate special design changes when a story demands them.

Undertaking a project of this size is no small task. **PC Magazine's** director of design and electronic publishing, Gerard Kunkel, teamed up with veteran magazine design consultant John Vogler (the last time Kunkel and Vogler worked together, they launched the current look of **Business Week**, already considered a design classic). Then Kunkel's staff of senior designers warmed up their 386-based machines, desktop publishing packages, and color PostScript printers and covered the walls of the art department with hundreds of sample pages and covers.

Though the design of the magazine has changed, you'll find that the lineup has not. The exceptions:

- **New on the Market** and **PC Update** have been combined into a new section called **New and Improved**.

- **Pipeline** has broken out of First Looks and become its own three-part section.

- **Communiqués** has been renamed **Abort, Retry, Fail?** and moved to the last page of the magazine.

But before you sneak a peek back there, take a look at what we've done to all the other pages of **PC Magazine**. We think you'll like what we see.

—Donald P. Willmott



Gift of the artists: **PC Magazine's** new look.

PC Magazine: The Independent Guide to IBM-Compatible Personal Computing. ISSN 0898-8617. Published biweekly except in July and August for \$10.00 per year (\$2.00 per issue). \$11.97 for two years. \$10.97 for three years. Additional postage \$1.00 per copy for Canada and all other foreign countries. 200-Club Publishing Co., a division of 200 Communications Co., One Park Ave., New York, NY 10016. Second-class postage paid at New York, NY 10016 and at additional mailing offices. POSTMASTER: Address changes to PC Magazine, P.O. Box 54093, Boulder, CO 80521-0933.



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Would you order from the same firm again?
Yes: 87.5%
No: 12.5%



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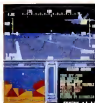
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IN ALL FAIRNESS, YOU SHOULD READ WHAT ASHTON-TATE* IS SAYING BEFORE YOU PURCHASE ORACLE.

Ashton-Tate Fights SQL Bugs Same Query Run Twice Can Result in Different Replies

Ashton-Tate last week acknowledged that the Structured Query Language (SQL) portion of dBASE IV can produce inconsistent and inaccurate results. The crux of the SQL problems lies with three scenarios that occur when data is structured in a specific way, according to Ken Richardson, a spokesman for the Thousand Oaks, Calif. firm. As a result, the same query run two different times can result in two different replies, for example, or a query

can retrieve incomplete information from the database (See Chart, Page 8).

Ashton-Tate does not plan to issue a database fix for the problem, it is, however, offering work-around solutions to users through its support lines and hot line board, and on CompuServe, Richardson said.

Though Ashton-Tate is characterizing dBASE IV's SQL problems to "minor" and confined to specific circumstances, database experts claim their impact is more serious.

"The SQL in dBASE IV is unstable, unreliable and unpredictable," said Richard Paderstein, president of Performance Computing Inc., a database consulting firm in Chicago.

"I don't see how anyone can use it," he added. "They'd have to know the answers to the SQL query ahead of time."

Surprisingly, the majority of dBASE users were unaware by dBASE IV's SQL glitches.

"The drawbacks in SQL are an

See ORACLE Page 8

PC Week, January 9, 1989

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PC MAGAZINE SAYS,
JANUARY 31, 1989

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Austin 286/12.5 Cache System			
Austin Standard System	Austin Hard Drive System	Price	
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4141	25 ms 1.1i	\$2395	
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	25 ms 1.1i	\$2795	
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Austin 286/12.5 Cache Standard Features:

- Intel 12.5 MHz 80286 Processor
- GE 1 Year On-Site Service Contract
- 14" EGA Color Monitor
- 16 Bit Paradise EEGA Autoswitch Display Adapter
- 40 MB-25 ms Super Fast Access Hard Drive
- 1:1 Fast Transfer Interleaving Controller Card
- 32K High Speed Hard Disk Cache
- Super PC Kwik Disk Caching Software
- 1 MB RAM (expands to 4 MB on board, 16 MB total)
- Shadow RAM Caching (BIOS Caching)
- EMS LIMM 4.0 Support
- American-Made MotherBoard
- 3.5" 1.44 or 5 1/4" 1.2 MB Floppy Disk Drive
- Phoenix BIOS
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- 2 Serial Ports & 1 Parallel Port
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AUSTIN 286/12.5 Comparison Chart

Features	Austin 286/12.5	Check Competition
GE 1 year on-site service	YES	
16 bit high speed display adapter	YES	
25 ms or faster hard drive	YES	
1:1 hard drive controller	YES	
Disk caching software tested as #1 in industry	YES	
32K hard disk cache	YES	
1 full MB of RAM	YES	
Shadow RAM	YES	
Surface mount construction	YES	
VLSI technology	YES	
I/O ports fully integrated	YES	
American made motherboard	YES	

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The Austin 286/20 Cache includes a VGA color monitor, 16 bit VGA color adapter, 40 MB-28 ms 1:1 hard drive, GE 1 year on-site service, 1 MB RAM, shadow RAM cache, Super PC Kwik disk cache software, 1.2 MB 5 1/4" floppy drive, 101 keyboard, and a full array of I/O ports. Complete at \$2695.00



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The Austin 386/20 Cache includes a 61K static RAM cache, VGA color monitor, 16 bit VGA color adapter, 80 MB-22 ms 1:1 hard drive, GE 1 year on-site service, 1 MB RAM, Super PC Kwik disk cache software, 1.2 MB 5 1/4" floppy drive, 101 keyboard, and a full array of I/O ports. Complete at \$3995.00



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	100 MB-25 ms 1:1	\$2795	\$2895	—
	280/20 Cache	\$2695	\$2795	—
	80 MB-22 ms 1:1	\$2795	\$2895	—
	110 MB-17 ms ESDI	\$3095	\$3245	\$3495
386/SX	150 MB-17 ms ESDI	\$3295	\$3495	\$3695
	10 MB-28 ms 1:1	\$2795	\$2895	—
	80 MB-22 ms 1:1	\$2895	\$3195	\$3395
	110 MB-17 ms ESDI	\$3195	\$3345	\$3595
	150 MB-17 ms ESDI	\$3395	\$3545	\$3795
386/20 Cache	40 MB-28 ms 1:1	\$2595	\$2695	—
	80 MB-22 ms 1:1	\$2895	\$3095	\$3295
	110 MB-17 ms ESDI	\$3195	\$3395	\$3595
	150 MB-17 ms ESDI	\$3395	\$3595	\$3795
	80 MB-22 ms 1:1	\$3195	\$3395	\$3595
386/25 HyperCache™	110 MB-17 ms ESDI	\$3495	\$3695	\$3895
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Steve Hui, President
Everex Systems, Inc.

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Letters

GETTING THE FAX STRAIGHT

Facsimile transmission has been around since the middle of the nineteenth century ("PC to Paper: Fax Grows Up," *PC Magazine*, April 11, 1989)? And I thought Abraham Lincoln was hard at work on the train ride from Washington to Gettysburg. He probably took a nap and told his White House speech writer to fax him a copy of the address when he arrived. Unless, of course, his speech writer was sitting around waiting for someone to invent the telephone.

Curtis Hoke
Reading, Pennsylvania

MISLEADING LETTERS

Hey *PC Mag*, wake up! You shouldn't let lead letters with glaring misconceptions go unchallenged. Steve Roth (Letters, *PC Magazine*, April 11, 1989) criticizes both the original LaserWriter and the Apple LaserWriter IINTX, bemoaning their IBM incompatibility.

Both printers support those newfangled serial connections that show up occasionally in the IBM architecture. Our IBM office has had a QMS PS 800 (LaserWriter work-alike) and Apple LaserWriter IINTX chugging along merrily for quite some time now. I am happy (nay, delighted) to sacrifice use of that dumb old parallel port in exchange for PostScript, the page description language for the discerning desktop publisher.

John Sayers
Falls Church, Virginia

THE REAL TAX EXPERT

For the second straight year I am using ChipSoft's *TurboTax* to prepare my taxes (After Hours, *PC Magazine*, February 28, 1989). Both years this marvelous program has simplified the yearly civic duty we all must bear.

My mother-in-law, however, consulted a local "tax professional," and within 25 minutes she owed Uncle Sam an extra thousand because of a lump-sum distribution from her profit-sharing plan. I vol-



The Gettysburg Address via fax?

unteered to do her taxes over with *TurboTax*'s Analysis Interview, and found an obvious oversight that her "experts" failed to catch.

Thanks to ChipSoft, my mother-in-law saved \$900, and I am a hero around this house. Now I can justify the telephone bills I run up on CompuServe and PC MagNet.

Richard Pierides
Seattle, Washington

MHZ HURTS

A number of companies are caught up in the "MHz race" with their products, and a few like to bend the rules and cheat on their processor speed or chip set speed ratings. They try to squeeze 12 MHz out of a 10-MHz processor. Not to be outdone, the next company squeezes 20 MHz out of a processor rated for 16 MHz, and so on. Maybe this poses no problem, but let's assume that the junction temperatures in the processor go up by 10 degrees Celsius or more when the speed is pushed; this equates to a halving of the life expectancy of that part. The MTBF will be adversely affected, and we may have a bunch of early processor deaths just waiting to happen to us poor unsuspect-

ing users who have been zipping along at zero wait states with our overstressed processors.

When a manufacturer such as Intel says a part is 10-MHz, that firm will not give anyone its blessing to run the part at 16 MHz. Does this mean that the warranty on my machine is automatically voided as soon as I hit the turbo switch? I feel as if I've been had by my dealer and wonder just how many unfortunate souls are in the same situation.

Jeff H. Walton
Maple Plain, Minnesota

YOU FORGOT MY SIDEKICK

Your review of some of the note-taking programs was wonderful ("Classified Intelligence: Managing Personal Information," *PC Magazine*, December 13, 1988). However, serious readers like myself hated the absence of Borland's champion *SideKick Plus* in your review. The Borland program far surpasses many of those you reviewed.

Syed M. A. Burney
Dammam, Saudi Arabia

PUBLISH SOME PRAISE, TOO

Apparently you feel constrained to publish letters in every issue criticizing your reviews. I hope you also will feel constrained to publish one praising them.

Last year, when I was considering 286 machines, your magazine recommended, "Get a 386." So I chose the Dell System 310 because it was an Editor's Choice ("Good and Fast: Fifteen 386s Push the Performance Standard to 20 MHz," *PC Magazine*, November 29, 1988). Based on your review, Dell's literature, and an equally enthusiastic review in another publication, I bought a System 310—and am delighted. Complex programs like *AutoCAD* and *Ventura Publisher* "fly" on it, the VGA Plus is great, and Dell is a joy to work with.

Keep up the good work!
Ed Blackburn
Glendale, California

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Letters

BEYOND THE PC UNIVERSE

I can't believe that Brook Monroe calls FORTRAN "a language that doesn't have the good grace to quietly die its well-deserved and long-overdue death" (Letters, PC Magazine, March 28, 1989).

There is a universe of computing out there beyond the realm of PCs, integrated software, and TSR goodies where scientists and programmers have better

Now that PCs are
entering mainstream
computing with
32-bit paths, high CPU
speeds, and math
coprocessors, the time
is long past due for
FORTRAN to get the
attention it deserves.

things to do than translate millions of lines of coding into the language *du jour*. FORTRAN survives because it is the best number-cruncher and, outside of the micro-computer world, the best-supported.

Now that PCs are entering mainstream computing with 32-bit paths, high CPU speeds, and math coprocessors, the time is long past due for FORTRAN to get the attention it deserves.

Lance R. Delo
Seattle, Washington

MAKING HIS OWN HISTORY

First 80286. Then 80386. Now 80486. I want to be the first to say it in print: 80586. There, I've said it! Now when anyone does an electronic search for the first citation of 80586, my name will pop up. And just to be sure, let me say this: 80686, 80786.

Thanks for helping me make history.
D. J. Jaffe
New York, New York

PC MAG MAKES FIRST-ROUND CUT

I've been using my IBM Model 30 for almost 2 years now, and I have to thank PC Magazine for one informative article after another. Although some of your topics are a bit over my head from a technical point of view, I like the idea of stretching the old gray matter to new hardware and software approaches. My next stretch will be to learn Turbo Pascal.

Although I currently subscribe to five other computer magazines, I am sure that if I have to cut down my obsession, PC Magazine will "make the cut."

James Lyons
Brooklyn, New York

LAYING DOWN THE LAW

John C. Dvorak is inaccurate in his statements regarding the legality of intercepting data communications (Inside Track, PC Magazine, March 14, 1989). While Title III of the Omnibus Crime Control Act of 1968 prohibited the interception of any wire communication or aural communication (where there was a reasonable expectation of privacy), the Electronic Communication Privacy Act of 1986, as passed by the United States Congress, addressed the technological advances in communications services.

Basically, the new law removed the word "aural" and replaced it with "electronic." Under the new law, nonconsensual interception of telefax communications, electronic mail, electronic telegrams, or digital paging devices is illegal. Violations are investigated by the FBI, and penalties upon conviction are imprisonment, fine, and liability for civil damages.

Lt. J. F. Higgins
Bibb County Sheriff's Department
Macon, Georgia

I feel obligated to write in regard to John C. Dvorak's article about the current fax craze. His comment recommending fax cards in PCs is ridiculous; there are so many inherent logistical and procedural problems with PC fax.

I don't think that he considered the privacy issue as it relates to using a PC: the same privacy abuses exist in the PC world. The problem is with personnel, not equipment. If privacy is an issue for a certain document, you can call before the document is sent and someone with proper authority will be at the fax machine when it arrives.

Kenneth R. Leebow
Marietta, Georgia



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Letters

KEEPING IT CHEAP

I disagree strongly with John C. Dvorak's calling the NEC V-20 chip an "oddball flop" ("Dvorak's Hall of Infamy," *PC Magazine*, April 11, 1989). Only 1

For those of us who
have XT clones and
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month ago I replaced the 8088-2 in my PC with a V-20. For \$10, the performance increase was more than worth the money. The fact that new machines are still being produced with this chip (the NEC Multi-Speed, for example) only proves this chip's durability as an improvement over an existing standard.

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Andy Silverman
Philadelphia, Pennsylvania

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Bruce R. Quick
Louisville, Kentucky

ACCOUNTING FOR TIME

When you review accounting packages, please report on compatibility in relation to 286/386, CPU speed, and also

video bus speeds such as 8- or 16-bit. I recently purchased a Gateway 2000 20-MHz 386, but Dac 3.0 accounting software is not able to run at 20 MHz. Even after I slowed it down to 12 MHz, my Paradise VGA Plus 16-bit video board is also too fast for this poorly written software. I was hoping to use the increased performance of the 386 to process billing and payroll more quickly, but as usual the Dac software is loaded with bugs, including resetting the Paradise board to CGA as well as timing out when making disk access.

Kevin Carrigan
President
Syslogic Technical Services
Tampa, Florida

CORRECTIONS/AMPLIFICATIONS

In "Driver's Ed: Choosing and Installing a 3½-inch Drive" (*PC Magazine*, April 25, 1989), two versions of Manzana MicroSystems' internal disk drive were confused. The \$199.95 disk drive (without MUX adapter card) is called the Manzana Internal Plus. The Manzana Third Internal Plus does come with a MUX adapter card (which has a standard controller interface) and costs \$289.95. A similarly equipped Sysgen Bridge-File 3.5 Internal System would actually cost \$320; thus the Manzana drive remains the less-expensive option.

The correct telephone number for RightSoft Inc., developer of *RightWriter*, Version 3.0 (First Looks, *PC Magazine*, February 14, 1989), is (813) 923-0244.

The price of PDI Music Software's *The Entertainer* (After Hours, *PC Magazine*, March 28, 1989) has been reduced to \$29.95, and it is now capable of 300 songs and sounds.

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- Dual Floppy/Dual H.D. Controller
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- Enhanced 101 Key Keyboard
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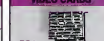


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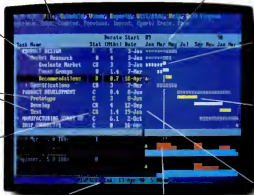
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CIRCLE 249 ON READER SERVICE CARD



Advisor

REORGANIZING ASCII DATA

Do you know of any software products that will allow me to rearrange the position of the fields of an ASCII fixed-field or comma-delimited file before I import them into my database?

Al Delgado
Laguna Beach, California

PC Two packages come to mind that will easily handle this task. Both give you the ability to reorder, sort, exclude, and filter data, as well as convert from ASCII to any number of popular data file formats.

The first, *AutoImport* (\$169.95; White Crane Systems, 6889 Peachtree Industrial Blvd., #151, Norcross, GA 30092; (404) 394-3119), presents a spreadsheet-like interface and Lotus-style menus. The other, *Data Junction* (\$195; Tools & Technologies Inc., 1620 W. 12th St., Austin, TX 78703; (800) 444-1945, (512) 482-0824), uses *Microsoft Word*-type menus and displays four records at the top of your screen.

A full review of *Data Junction* appears in First Looks on page 36 of the April 11, 1989, issue of *PC Magazine*.

WORD 4.0 FOR TECHNICAL TYPES

As an R & D engineer, I often have to write technical reports. My problem is that the ASCII character set doesn't offer the complete Greek alphabet. Is there any way I can create my own soft fonts or character sets for use with *Microsoft Word* 4.0 and my laser printer?

Gregor Matthias
Munich, West Germany

PC You don't need to reinvent the wheel by creating your own soft fonts: Bitstream's \$195 *Symbols I Fontware Typeface Package* (215 First St., Cambridge, MA 02142; (617) 497-6222) will create them for you. It provides proportional and monospaced technical fonts of any size, and on-disk documentation shows which keyboard character corresponds to which symbol.

■ **REORGANIZING ASCII DATA:**
Prepping your data for import.

■ **WORD 4.0 FOR TECHNICAL TYPES:**
Writing technical documents with Word.

■ **THE WIDE WORLD OF TELECOMMUNICATIONS:**
Going on-line for the first time.

■ **GRAPHICS AT YOUR COMMAND:**
Creating a printer-ready graphics file.

You'll also need software to install the new fonts. If you purchased *Word* after July 1, 1988, you probably received a free copy of Bitstream's *Fontware Installation Kit*; otherwise, you can buy the kit for \$95. SoftCraft's *Laser Fonts* (\$199; 16 N. Carroll St., #500, Madison, WI 53703; (800) 351-0500, (608) 257-3300) will also install the fonts for use with *Word*. SoftCraft's *Laser Fonts* provides more-transparent font management than Bitstream's product; it puts the font information into your printer driver, so the new fonts appear on the list you pull up with F1 when you choose Format Character in *Word*.

THE WIDE WORLD OF TELECOMMUNICATIONS

For years I avoided having anything to do with modems: I saw no need for buying one and regarded them as the gateway to a black hole that would eat up all my remaining time and money.

But things have changed. I recently decided that it would be helpful for me to keep

in touch with my computer from my clients' offices, so I invested in a 2,400-bit-per-second modem. Now I need to catch up on the technology. Where do I start? Do I need to worry about viruses? Are services like CompuServe worth the money? What obvious traps can I avoid?

Lyndon Gibbs
Westminster, Maryland

PC The best place to start is at your neighborhood bookstore, where you can pick up a copy of Alfred Glossbrenner's book *The Complete Handbook of Personal Computer Communications* (\$14.95; ISBN 0-312-15760-6; St. Martin's Press, 175 Fifth Ave., New York, NY 10010; (212) 674-5151).

Although last revised in 1985, the book still contains lots of useful information. It guides you through buying a modem and communications software, and it explains the technical details of telecommunications, from bits to parity to protocols. In addition, Glossbrenner describes how and why to join and what to expect from many on-line services, such as CompuServe, The Source, and various local bulletin board systems.

Of course, a lot has changed in 5 years, so some of the information is out of date—especially where it's related to connect charges and the breadth of services offered—and some services have gone to that great bulletin board in the sky. But the book is still a good resource for the virgin telecommunicator.

GRAPHICS AT YOUR COMMAND

My fax board supports .IMG, .FAX, .TIF, .PCX, and .PCC file formats. I need to print the faxes that I receive from within my own BASIC program, and if I were able to issue a DOS PRINT command, I could use the BASIC SHELL statement.

Is there a software package available that will let me print these graphics files from the DOS command line?

Gopal Miglani
Des Moines, Iowa

Advisor



To print a graphics file from the DOS command line, you first need to translate the file into a language that your printer will understand. Therefore, you can't print the files in their native formats from within your BASIC program without an intermediate step.

If you already own a graphics package, check to see if it will let you import your images and print them to a disk file (the same way, for example, you create a .PRN file of a Lotus 1-2-3 worksheet). Otherwise, Inset Systems (71 Commerce Dr., Brookfield, CT 06804; (203) 775-5866) offers a \$99 TSR screen-capture and graphics-format-conversion package that should do the trick.

HiJaak, Version 1.1B, performs raster-to-raster, vector-to-raster, and vector-to-vector conversions between most popular graphics file types, including all the ones you've mentioned (except .PCC).

More important for you, though, it also converts these formats to PCL (HP's printer control language) for output on an HP

LaserJet-compatible printer. The syntax of the software's Convert command resembles the DOS COPY command: you specify the output format simply by using

**To print a graphics
file from the DOS
command line, you
first need to
translate the file
into a language that
your printer will
understand.**

the appropriate extension in the name of the target file. This means that you can convert as well as print the image from within BASIC.

Unfortunately the graphics printed this way tend to be small: a full-screen image will shrink to approximately 2½ by 1½ inches. This may suit your purposes, but if you want a full-size picture, you'll also need the company's \$99 graphics editing package, *Inset*, which will let you expand the image and save it in the package's printer-ready .GNT format. (You can buy *Inset* and *HiJaak* together for \$149.)

If you have software that will display images on-screen, then you don't need both packages—you can capture and process the image with just *Inset*. If not, you'll need to convert your fax image into a .PIX file with *HiJaak*, next use *Inset* to view and expand the image, and then capture it to a .GNT file for printing. Unlike *HiJaak*, *Inset* can't operate from the command line, but you can write macros to automate the process; thus, conversion can still be carried out from a BASIC shell.

ASK THE ADVISOR

Send your questions to Advisor, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload to PC MagNet (see the Utilities column for access information). Please specify your equipment. ■

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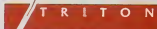


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CIRCLE 195 ON READER SERVICE CARD

First Looks

Hands-on Reviews of the Latest Products

WordPerfect for OS/2 Maintains Look, Performance Of Its DOS Counterpart

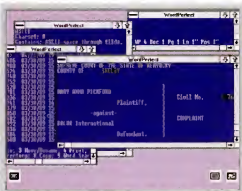
HANDS ON
by Tony Rizzo

After months of waiting for the mainstream business applications that would make OS/2 a useful alternative rather than an interesting possibility, the first word processor for OS/2 is here: *WordPerfect for Operating System/2*. The powerful \$549 program joins databases as another of the Big Five applications that have made their way to OS/2 from DOS. Like other ports, *WordPerfect for OS/2* retains so much of the look and feel of its DOS counterpart that it's difficult to tell them apart.

In fact, casual observers won't be able to distinguish between the DOS and OS/2 versions of the program when it is run in a full-screen session. Except for such minor changes as "Go to OS/2" rather than shelling out to DOS, the two versions are visually the same. *WordPerfect's* installation program takes care of OS/2-specific differences in CONFIG.SYS file entries, such as where DLLs are stored, what a LIBPATH is, and the inclusion of an IOPL=YES statement. The familiar WP.FIL file is now part of WP.EXE itself.

The look and feel haven't changed, but the 640K memory limitation has. When you use the OS/2 version of *WordPerfect*, you won't have to count sheep while your system performs a labor-intensive mail-merge operation. You'll also be

CONTINUES ON PAGE 35



You can view multiple copies of *WordPerfect for OS/2* in Presentation Manager text windows.

Compaq Deskpro 286e: Small Footprint, Workaday Speed

HANDS ON
by Jonathan Matzkin

The Compaq Deskpro 286e reflects the massive changes the PC industry has seen in just a short time. Three years ago this 12-MHz desktop would have been considered a thundering hot rod. Today, midrange AT-class machines like this are the absolute minimum necessary in many offices. Let's face it, these machines are to the '80s what electric typewriters were to the '60s.

The 286e will compete in the

relatively low-tech market for basic 286s, where IBM and Compaq no longer dominate as completely as they once did. Budget-conscious managers seek the same qualities in their ATs that they look for in any other kind of basic office equipment. They want solid performance, strong support, and no surprises when it comes to compatibility.

Compaq aims the Deskpro 286e straight at those needs. The machine's performance has been deliberately throttled back in order to guarantee the com-

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patibility that Compaq's reputation is founded on.

When we ran the PC Labs benchmark tests on the Deskpro 286e, the results pegged the machine's clock speed at 11.8 MHz, rather than at the 12 MHz that Compaq reports. However, the 286e is, in fact, a 12-MHz system. Compaq's design philosophy accounts for the discrepancy and is consistent with Compaq's earlier offerings: all of the company's 12-MHz machines show the same test results.

The 286e's memory refresh cycle runs at 8 MHz, in the interest of assuring compatibility with expansion-bus add-in hardware. I/O operations on the expansion bus involve DMA

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First Looks

Compaq Deskpro 286e

CONTINUED FROM PAGE 30

(direct memory access), and Compaq opted to keep DMA running at a pace unlikely to conflict with anything that would have worked in the expansion bus of an 8-MHz IBM PC AT. The net effect is slower performance. Processor speed can be toggled between 8 and 12 MHz.

Compaq reports that its decision to slow memory performance is in the interest of preserving compatibility. Many PC add-in cards (older ones in particular) choke at speeds at or around 12 MHz, and Compaq's engineering decision means that such problems are unlikely to occur.

That warm feeling of compatibility comes at a definite price, however. The 286e performs solidly but unspectacularly in our tests. On the 80286 Instruction Mix test, it clocks in at 6.04 seconds. If the 286e had been included in our last roundup of 12-MHz ATs, that result would have placed it dead last among the 13 machines we reviewed (see "Crowd Pleasers: Entry-Level 12-MHz 286s," *PC Magazine*, January 31, 1989).

In the same company, the 286e also finishes last on the 128K NOP loop test, which is a basic test of raw processor performance. The Deskpro's 2.85-

second time puts it only a few hundredths behind a group of ATs that clocked in at 2.80 seconds. But it lags more than a tenth of a second behind several machines, like the ALR Dart 12.5 Model 30 and the Zeos 286/12.

On the DOS File Access test for small records, the 286e, like a number of other machines, performs slower than an original IBM PC AT. Here it should be noted, however, that only four of the systems we tested in the 12-MHz roundup managed to outrun the original AT on this test. On the DOS File Access test for large records, the 286e's performance would have placed it among the fastest machines in that group.

The physical design of the Deskpro 286e incorporates plenty of flexibility and room for expansion in its small-footprint (5.9- by 15.8- by 14.8-inch, HWD) case. One megabyte of memory is standard, and additional RAM can be installed in a single proprietary 16-bit slot reserved for memory expansion. The 286e accepts a total of up to 13MB of RAM.

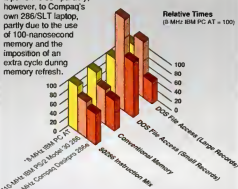
Since the memory slot takes care of any needed RAM upgrades, the four industry-standard slots are all available for whatever upgrade options the user decides to install. Those slots seem like more than enough growing space when you consider all of the electronics that Compaq integrates into the Deskpro's motherboard. The VGA adapter and the hard and floppy disk controllers are integral, as are one serial port, one parallel port, and a mouse port.

The 286e accepts up to four internal storage devices. Our review unit came with two floppy disk drives and a tape drive, all half-height, mounted one on top of the other in a single cutout in the case's front panel. It also had an internal 40MB hard



BENCHMARK TESTS: 12-MHz COMPAQ DESKPRO 286e

Our benchmark tests—especially the 80286 Instruction Mix and Conventional Memory tests—indicate that the Compaq Deskpro 286e operates more slowly than most 12-MHz ATs we've tested. It performs comparably, however, to Compaq's own 286/SLT laptop, partly due to the use of 100-nanosecond memory and the imposition of an extra cycle during memory refresh.



Performance Times (Times given in seconds)	80286 Instruction Mix	Conventional Memory	DOS File Access (Small Records)	DOS File Access (Large Records)
*8-MHz IBM PC AT	8.96	1.32	54.32	16.22
*10-MHz IBM PS/2 Model 50	7.09	1.00	110.46	19.94
12-MHz Compaq Deskpro 286e	6.04	0.88	66.29	7.57

*This product was not reviewed, but we are reporting its test results for comparison.

The 80286 Instruction Mix benchmark test times a series of tasks specific to the 80286 chip. Since this test shows how the CPU operates in the context of the bus, processor, system memory, and motherboard architecture, a faster time means better overall computer performance.

The Conventional Memory benchmark test measures the read/write speed of the first 640K of memory. Slower relative times can indicate the presence of memory wait states or memory chips rated at slower access speeds.

The DOS File Access (Small Records) benchmark test times disk

throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. The test is performed without software disk caching. Fast times are advantageous for programs that work with many short segments of disk.

The DOS File Access (Large Records) benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. This test minimizes the effect of small hardware caches on disk subsystem performance. It is performed without software disk caching. Fast times are advantageous when large files are loaded.



The Compaq Deskpro 286e is a solid but not stellar performer.

disk, which was rated at 29 milliseconds but performed at 27 ms. Compaq offers disks up to 110MB in size.

The Deskpro's 140-watt power supply should be adequate for the four-slot expansion bus. Compaq keeps power consumption down by using CMOS technology to a considerable extent in the 286e.

Compaq's new Deskpro may be aimed at a stiffly competitive market, but the company clearly has chosen not to compete on price. Compaq's in-

dustry-leading reputation for quality, compatibility, and support commands a pretty penny. The basic Deskpro 286e Model 1 carries a moderate list price of \$2,699. That includes the standard 1MB of memory, VGA support (no monitor), a single 1.2MB floppy disk drive, and no hard disk.

The Model 20, at \$3,399, adds a 20MB hard disk. \$3,999 buys you the Model 40, which beefs up the package with a 40MB hard disk drive.

It's a bit unfair to criticize

Compaq's price structure by comparing it with the discount prices offered by some competitors. Compaq sells more than the raw performance of its products; users expect a higher degree of reliability and service from Compaq than from most other vendors.

In that light, the Deskpro 286e is consistent with previous Compaq offerings. It is not a standout performer among its 12-MHz brethren, but it is a capable, well-engineered system. It provides the flexibility, power, and compatibility that many users find indispensable. ■

PC FACT FILE

Compaq Deskpro 286e
Compaq Computer Corp.,
20555 FM 149, Houston, TX
77070; (713) 370-0670.
List Price: Compaq Deskpro
286e Model 1, with hard and
floppy disk controllers; 1.2MB
floppy disk drive; integral VGA
support; serial, parallel, and
mouse ports: 1MB RAM;
\$2,699. Model 20, with 20MB
hard disk, \$3,399. Model 40,
with 40MB hard disk, \$3,999.
In Short: Compaq's new
Deskpro 286e provides solid,
yeoman-like performance for
your general business
applications.

CIRCLE 486 ON READER SERVICE CARD

WordPerfect

continued from page 33

able to load a 400K file completely into memory. And although you can run the DOS version of WordPerfect in the OS/2 Compatibility Box, you can run only one copy of it at a time. Under OS/2, you can run multiple copies of WordPerfect simultaneously and switch among them as needed. Users of the program's graphics features will clearly benefit from being able to start up multiple sessions of WordPerfect and switch rapidly among different designs and views, each of which might be printed. Of course, the benefits of virtual-memory accessibility and multitasking come from using OS/2, however, not from WordPerfect itself.

WordPerfect Corp. reports that it is possible to run up to 99

copies of the program. Although no user would ever want to do that, it's impossible to verify the company's claim, since OS/2 1.1 can run only a maximum of 16 Presentation Manager text window sessions and a maximum of 12 full-screen sessions.

In an attempt to make clear which copy of the program is running, WordPerfect for OS/2 adds that information (in the form of WP1, WP2, and so forth) to the status line. If this feature were better implemented, it would be very useful. But as it stands, if you close the third copy of the program and start another, the system reports that a fourth copy of WordPerfect has been started. If all copies of the program have been closed, the counter is reset to 0. If only one copy is running, the status line does not display a WP1 tag.

Although the best way to run WordPerfect for OS/2 is in full-screen sessions, you can view multiple copies of the program in Presentation Manager text windows, which have some visual appeal. If you are going to start running a report and then switch to another copy of WordPerfect, text window operation is fine. However, a PM text window is not the place for real word-processing work. First, the screen becomes very cluttered. Second, a PM text window will not support any of Version 5.0's graphics-previewing capabilities.

You can still import graphics images, but you cannot view them in preview mode, since a PM text window cannot go into graphics mode. Any attempt to preview a WordPerfect file with an imported graphics image in a PM text window will invoke the message "Error: Invalid Graphics Driver." This error message is misleading and might cause a user to spend an awful lot of time trying to find the nonexistent driver. The program should really report that an illegal operation in a PM text window was attempted. In full-screen sessions, however, all graphics features are fully supported, and preview mode displays graphics images perfectly. WordPerfect for OS/2 comes with a solid collection of printer drivers and

was able to drive my HP LaserJet Series II without a hitch.

Despite the similarities between WordPerfect for OS/2 and its DOS counterpart, the new version lacks some features that experienced users will miss. For example, Repeat Performance (which provides cursor control features such as skid squelch and adjustable delay) and GRAB, a screen capture utility, are not available. If you're accustomed to seeing on-screen italics, underlined fonts, and other similar embellishments, you will find that the OS/2 version is lacking in this area as well, since OS/2 will not let an application gain access to on-screen fonts. Instead, you will have to rely on different foreground/background color combinations to indicate on-screen font changes.

As a character-based OS/2 application, WordPerfect for OS/2 is an interim product created to hold down the fort while the next release, which will run in the PM environment, is ready. That version, which is expected out in the fourth quarter



FACT FILE

WordPerfect for Operating System 2

WordPerfect Corp., 1555 N. Technology Way, Orem, UT 84057; (801) 225-5000.
List Price: \$549; upgrade from WordPerfect 5.0 for DOS, \$75.
Requires: 2MB RAM for OS/2 1.0, 3MB RAM for OS/2 1.1.
In Short: Despite a very minor loss of features, a complete and stable OS-2 implementation of WordPerfect 5.0 is sure to be of great use to heavy WordPerfect users.

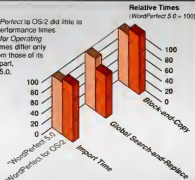
CIRCLE 483 ON READER SERVICE CARD

of this year, will probably be your best bet if you don't have a pressing need for an OS/2-compatible word processor. In the meantime, a mere \$75 will buy you the privilege of upgrading from the DOS to the OS/2 version, bringing with it all the advantages that running applications under OS/2 has to offer. That said, I'm retiring the DOS version for good. ■



PERFORMANCE TESTS: WORDPERFECT FOR OS/2

Porting WordPerfect to OS/2 did little to increase its performance times. WordPerfect for Operating Systems 2's times differ only marginally from those of its DOS counterpart, WordPerfect 5.0.



Performance Times (Times given in seconds)

	Import Time	Global Search-and-Replace	Block-and-Copy
*WordPerfect 5.0	6.30	25.50	2.40
*WordPerfect for OS/2	6.80	20.90	2.70

*This product was not reviewed, but we are reporting its test results for comparison.

The **Import Time** test measures the amount of time required to import a 50K document.

The **Global Search-and-Replace** test measures how long it takes a word processor to replace 115 cases of the word *hi* with the word *there*.

The **Block-and-Copy** test takes a three-page block and copies it to an external file. The test requires target-size page reformatting that slows the performance of some programs, depending on how well they handle the task in a RAM buffer. The larger the buffer, the faster the results.

KnowledgePro Uses Hypertext, Expert System Rules to Build Applications

HANDS ON
by Richard Hale Shaw

Some developers shy away from using expert systems and hypertext to build applications, because they believe those technologies require big investments in money and time in order to be employed effectively. *KnowledgePro* lets developers who have not used those approaches try a new way of creating applications without spending a fortune in doing so.

A traditional expert system applies rules or conditional statements stored in its knowledgebase to answer questions posed by a user. In that arrangement, the usefulness of the program's response depends on how well the developer structures the knowledgebase.

Somewhat different, *KnowledgePro* is a knowledge processor: although it uses a high-level programming language to store rules and other information in a knowledgebase, the \$495 program allows your applications to communicate expertise without being constrained by a predefined rule-based structure. Since the program lets you integrate hypertext in your applications, a user can "press" a "button" to access additional information about a term or concept.

KnowledgePro's use of hypertext allows an application to provide information to the user dynamically. A developer can design an application so that it hides detailed information from those who don't want it and displays it to those who do. In addition, *KnowledgePro* lets you build a system that determines the content of the information it provides based on the user's earlier selections.

The program includes a full-

screen editor for creating and modifying a knowledgebase. Each knowledgebase is an ASCII file that the program automatically compiles whenever you change it (source files use a .KB extension, compiled knowledgebases use .CKB). The editor uses *WordStar* editing keys, but you can specify your own editor if you wish.

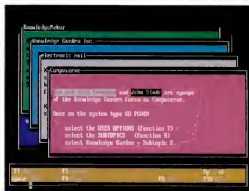
If you've selected a knowledgebase and then call up the editor, *KnowledgePro* will prompt you with the name of the source file for that knowledgebase. But a problem occurs if you haven't selected a knowledgebase and just enter *.KB at the prompt. *KnowledgePro* will treat this as a file, rather than bring up a list of files. Nor does

function-key prompts, and so forth—resides in a window. You can use function keys to access help, select a hypertext button, view a hypertext selection, evaluate an expression, or debug a knowledgebase.

The programming language includes only seven rules of syntax. Although there are more than 100 commands, you need to learn only six to get started. These commands display text, ask the user a question, create a hypertext button, make a knowledgebase decision, and open and close a window.

The building block of the programming language is the "topic," which is like a function or procedure in C or Pascal. If you link a hypertext button to a topic, *KnowledgePro* will execute the topic when the user selects the button. You can create your own topics, which use hypertext windows and buttons, or call other topics. Topics can also run programs and DOS commands.

The *KnowledgePro* programming language facilitates using hypertext. You can create a hypertext button by surrounding its text with "#m" in the



By using hypertext, *KnowledgePro* lets you access extra information about a term by "pressing" a "button."

it correctly diagnose the problem when you try to save the file with this name.

Despite this glitch, *KnowledgePro's* interface is easy to use, and its programming language is easy to master. Everything—the application, the

knowledgebase and creating a topic with the same name. There doesn't seem to be any limit to the number of hypertext links you can create. Hypertext buttons are accessible with a mouse, which makes the program a dream to use.



FACT FILE

KnowledgePro

Knowledge Garden Inc., 473A
Malden Bridge Rd., Nassau,
NY 12123; (518) 766-3000.

List Price: \$495; Graphics
Toolkit, \$89; Database Toolkit,
\$49.

Requires: 640K RAM, hard

disk, DOS 3.0 or later.

In Short: A powerful
application-development
system that uses expert system
rules and hypertext but doesn't
require you to be an expert in
either. Includes a compiler and
an editor.

CIRCLE 488 ON READER SERVICE CARD

KnowledgePro lets you access all your system's resources (printer, disk files, etc.) from within a *KnowledgePro* application. You can also search directories and execute DOS commands and programs. There is even a facility for calling functions written in Pascal, C, or assembler. However, you can do this only by including them in a special TSR program that *KnowledgePro* can access.

In addition, the program includes facilities for debugging applications. If a syntax error occurs while *KnowledgePro* is compiling a knowledgebase, you can load the editor and it will jump to the line where the error occurred. You can trace *KnowledgePro's* execution of the knowledgebase and have it display each line on the printer or the screen. When you are ready to distribute a *KnowledgePro* application, you can disable both the editor and the debugger. And the package includes a runtime module, which you can distribute on a royalty-free basis.

Two optional packages increase *KnowledgePro's* capabilities. A Database Toolkit (\$49) lets your *KnowledgePro* applications read *dBASE III Plus* and *Lotus 1-2-3*. WK1 files. The Graphics Toolkit (\$89) lets you add graphics to your applications by letting you link a picture of an item to a hypertext button. These useful additions build on an already powerful application-development system that's easy to use. ■

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CIRCLE 299 ON READER SERVICE CARD

First Looks

Laser Printers Get HPGL Support in a Cartridge

HANDS ON
by Alfred Poor

It used to be that if you wanted your laser printer to emulate a plotter, you would have to buy one with that capability built into its controller, or you had to run a separate utility that ate up valuable RAM or made you plot to disk. But now there's another way. Pacific Data Products has managed to put an HPGL-emulation program into a cartridge and in the process has created an incredibly fast way of printing graphics on a laser printer.

The \$395 Plotter in a Cartridge fits into the left-hand slot of an HP LaserJet Series II or Canon LBP-8II. (It is not compatible with the HP LaserJet IID.) You can still use a font cartridge in the other slot; it's even accessible when the plotter-emulation mode is active. You can switch between plotter (HPGL) and printer (PCL) modes either by using a pair of

batch files (included on a disk) or by pressing buttons on the front panel of the printer.

To find out just how much faster it is to print in the cartridge's plotter mode than it is in the LaserJet's plain PCL mode, I decided to print a map that I created using *Harvard Graphics*. Printing at the highest resolution, the LaserJet took 1 minute and 56 seconds in laser printer mode, compared with a mere 31.7 seconds in plotter mode. Even more significant, I

The Plotter in a Cartridge houses an HPGL-emulation program that speeds graphics printing on a laser printer.



regained control of *Harvard Graphics* in less than 7 seconds under plotter mode, compared with having to wait more than a minute and a half under PCL mode. That's quite a gain.

The Plotter in a Cartridge isn't just for people who use plotters—it's for anyone who prints graphs or charts or any other presentation materials and wishes to cut his or her printing time to a fraction of what it is currently. This product is an excellent value.

List Price: Plotter in a Cartridge, \$395. **Requires:** HP LaserJet Series II (with a minimum of 1.5MB RAM) or Canon LBP-8II laser printers. **Pacific Data Products**, 6404 Nancy Ridge Dr., San Diego, CA 92121; (619) 552-0880.

CIRCLE 438 ON READER SERVICE CARD

The on-board BIOS lets you boot from a 1.4MB disk in a PC or XT.

If you use a version of DOS earlier than Version 3.2, the board comes with software and instructions that let you use it almost as conveniently as with later versions.

Micro Solutions' \$125 CompatiCard I is a one-third-size card that fits easily in the short slot of an XT. But it doesn't come with an on-board BIOS, and if your computer's own BIOS doesn't support 3½-inch drives, you have to support them with the board's proprietary software driver. You can't use DOS's *DRIVER.SYS* alone, as you can with controllers that have a built-in BIOS. But the CompatiCard's software can be set up to work together with DOS's *DRIVER.SYS* to reduce the need for the proprietary disk-formatting utilities that are generally needed for disks supported by proprietary drivers.

Micro Solutions' optional *UniForm-PC* software (\$69.95) lets the controller read almost any nonstandard DOS disk or 5¼- or 8-inch CP/M disks, capacities that aren't built into the Northgate board. If you don't need external drives, you can choose the \$95 CompatiCard II, which will also work with *UniForm-PC* to read 5¼-inch CP/M disks.

The Northgate board has the advantage of built-in hardware support that lets you use your drives without worrying about software. The Micro Solutions board offers the last word in compatibility with other formats and operating systems. **List Price:** Northgate Universal Floppy Disk Controller, four-drive model, \$119; two-drive model, \$59. **Northgate Computer Systems Inc.**, 13895 Industrial Park Blvd., #110, Plymouth, MN 55441; (800) 548-1993, (612) 553-0111.

CIRCLE 439 ON READER SERVICE CARD

List Price: CompatiCard I, \$125; two-drive CompatiCard II, \$95. **Micro Solutions Inc.**, 132 W. Lincoln Hwy., De Kalb, IL 60115; (815) 756-3411.

CIRCLE 437 ON READER SERVICE CARD

Two Ways to Link Any Floppy Disk Drive to a PC

HANDS ON
by Edward Mendelson

The process of adding a floppy disk drive to a computer that wasn't designed for it starts out as a daydream of convenience but often ends as a nightmare of incompatibility. If you're trapped in that nightmare, two advanced floppy controllers from Northgate and Micro Solutions will let you sleep soundly again. These controllers are designed to handle any combination of drives you can dream up. They let you use high-density drives in a PC or XT or install up

to four floppy disk drives in an AT or 80386 machine. You can even hook up an 8-inch drive for detente with CP/M computers.

These controllers support external drives for computers whose drive bays are already packed with a floppy disk drive and a tape drive. They also let you add a third or fourth internal floppy disk drive to use if you want to copy disks easily between two drives but also want both 5¼- and 3½-inch formats in your machine. Both controllers can serve as secondary controllers when you want to supplement rather than replace the

existing controller.

With its three banks of DIP switches, Northgate Computer Systems' \$119 Universal Floppy Disk Controller looks daunting, but in most cases you can plug it in and forget it. You'll have to reset the DIP switches only if you use a nonstandard set of drives or to resolve conflicts between the controller and other boards.

The controller is a two-thirds-length card that may be inconvenient to use in PCs or XTs because it won't fit into the short slots near the floppy disk drives; you may have to thread the cables over other expansion cards. But the Northgate board comes with a BIOS that lets you use high-density 3½-inch disks without any special fuss or software, even in a PC or XT, provided you use DOS 3.3 or later.

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Then consider that Verbatim DataLifePlus™ and DataLife HD 5¼" disks were the first floppies to be factory formatted.

Verbatim also gives you plenty to consider when it comes to data protection. After all, nearly 50% of all computer users have lost time and money due to accidental data loss. That's why Verbatim offers advantages like DataHold™ and DataHold II

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CIRCLE 260 ON READER SERVICE CARD

First Looks

ALR FlexCache 33/386 Sets New Performance High

HANDS ON
by John Dickinson

Advanced Logic Research (ALR) is out to prove that southern Californians can stomp all over Texans and even upstate New Yorkers when it comes to producing high-performance PCs. Its new 33-MHz 80386 PC, the ALR FlexCache 33/386, shows that the company means business. The floor-standing ALR FlexCache 33/386 offers the very high performance required for heavy-duty CAD, graphics, and file-serving applications.

The FlexCache 33/386's innovative use of memory management allows it to achieve maximum performance while at the same time lets users minimize the cost of RAM memory.

For starters, the FlexCache 33/386 has a huge 128K cache populated with 25-nanosecond static RAM chips and managed by a new proprietary cache controller designed by ALR. The write-back controller accesses data from the cache in 64-bit blocks rather than in the 32-bit blocks used by cache controllers such as Intel's 83385. The controller also does parallel addressing, which means that both cache and main memory are accessed at the same time.

To ensure maximum memory performance, ALR supplies 60-ns. RAM chips for the first 2MB of memory in the FlexCache 33/386. The system-board-mounted memory is designed for 1-megabit SIMMs, but 60-ns. versions are not yet available, so ALR is assembling custom-made modules for its customers. The rest of the up to 16MB of system-board-mounted main memory can be composed of 60-, 80-, 100-, or 120-ns. RAM chips. Except for 60-ns. memory, standard SIMMs can be used. But you must set a jumper for each bank to let the

FlexCache memory-management logic know the speed of the chips being used.

All of this means the FlexCache 33/386 should be quite a performer. And it is. The FlexCache 33/386 raced through the PC Labs 80386 Instruction Mix benchmark test in 1.66 seconds. And the FlexCache 33/386 is faster than Zenith's new 33-

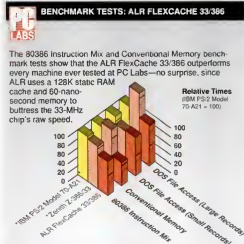
MHz Z-386/33; ALR runs the same benchmark test in about 80 percent of the time required by the Zenith. Perhaps more telling, the FlexCache 33/386 runs the PC Labs Conventional Memory benchmark test in .17 seconds.

Disk times for both the ALR and Zenith 33-MHz machines were faster than those of the IBM in the PC Labs DOS File Access (small record) test, but the ALR is faster than those two competitors in the PC Labs DOS File Access (large record) test. ALR ships Multisoft's PC-Kwik disk-caching package with the FlexCache 33/386, and disk performance goes up when it's installed.

The FlexCache 33/386's new six-layer system board has most of its logic components housed in surface-mounted packages. It can accommodate either the Intel 80387 or Weitek 3167 math coprocessor, both available in 33-MHz versions.

Besides the system board, the FlexCache 33/386's cabinet houses a 150MB or 300MB 18-millisecond hard disk that is shock-mounted on a swing-out platform. The platform can also hold an additional 3 1/2-inch hard disk, and the cabinet can house four additional half-height devices, including the standard 1.2MB 5 1/4-inch floppy disk drive. One of the 33/386's eight AT-compatible expansion slots comes filled with ALR's 16-bit SuperVGA board, which produces 800 by 600 resolution in addition to standard VGA features. The base price for the FlexCache 33/386 is \$9,990 for the Model 150 (150MB hard disk) or \$15,990 for the Model 300 (300MB hard disk).

At the same time ALR introduced the FlexCache 33/386, it also announced the FlexCache 33/386Z, a small-footprint machine that offers power-user-grade performance at a low entry price of \$3,995. That figure includes a 16-bit ALR Super VGA card and single 1.44MB 3 1/2-inch floppy disk drive. Hard disk options are priced reasonably as well, and the most you'll have to spend for the top-shelf Model 120 is \$6,395. ■



Performance Times (Times given in seconds)	80386 Instruction Mix	Conventional Memory	DOS File Access (Small Records)	DOS File Access (Large Records)
*IBM PS-2 Model 70-A21	2.19	0.33	72.37	6.77
*Zenith Z-386/33	2.08	0.36	60.65	9.83
ALR FlexCache 33/386	1.66	0.17	61.83	5.16

This product was not reviewed, but we are reporting its test results for comparison speed, hard disk controller function, and bus speed. The test is performed without software disk caching. Fast times are advantageous for programs that work with many short segments of data.

The **DOS File Access (Large Records)** benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. This test minimizes the effect of small hardware caches on disk subsystem performance. It is performed without software disk caching. Fast times are advantageous when large files are loaded.

The **DOS File Access (Small Records)** benchmark test times disk throughput as a result of mechanical disk drive

FACT FILE

ALR FlexCache 33/386

Advanced Logic Research Inc.,
9401 Jeronimo, Irvine, CA
92718, (800) 444-4257, (714)
581-8770.

List Price: Model 150, with
2MB DRAM, 150MB hard disk,
1.2MB floppy disk drive, one
serial port and one parallel port,
16-bit VGA adapter, \$9,990.
Model 300, with 300MB hard
disk, \$12,990.

In Short: The ALR FlexCache
33/386 races through the PC
Labs benchmark tests
delivering the high performance
needed for CAD, graphics, and
file-serving applications.

CIRCLE 438 ON READER SERVICE CARD

First Looks

Taesung UPS Provides Standby Power, Noise Filtering

HANDS ON
by Winn L. Roach

If a reliable source of electricity is something your local utility isn't, you'll appreciate the Taesung UPS-3160P from Taesung Industries. The combination backup power system and control center delivers more than enough juice to get you through the thirstiest blackouts, yet it's small enough (3 by 16 by 11 inches, HWD) to fit atop even a compact PS/2. With its 300-watt rating, built-in noise filtering, and surge suppression, the \$395 system rates as some of the best electrical insurance you can add to any PC.

Although its name would suggest otherwise, the UPS-3160P is not a true uninterruptible power system. Instead, it is a standby system that switches to inverter-and-battery power only during a power failure.

The unit's twin 6.5 amp-hour gelled-electrolyte batteries are rated as capable of delivering full power for 8 minutes, half power for 20, in the event of an outage. Testing proved the veracity of this claim. Once fully charged, the UPS-3160P generated well-regulated modified square waves to an AT-compatible and VGA monitor-equipped test system for 22.5 minutes before blacking out.

To warn when it was operating in battery-powered backup mode, the UPS-3160P beeped at 3- to 4-second intervals until about 1.5 minutes of backup power was left, then switched to a continuous tone to warn of its imminent failure. That's a warning to heed: the system abruptly switches itself off instead of allowing a dangerous



The Taesung UPS-3160P is small enough to fit atop even a compact PS/2.

undervoltage to pass on to your computer.

The output voltage of the UPS-3160P is quite well regulated. Starting out at a somewhat high 125 volts when it switched to battery power, the

output voltage crept up to 131 volts just before final shutdown.

Even when utility power is available, the UPS-3160P serves as a power control center. The rear panel of the unit has three battery-power-protected outlets and two unprotected outlets, all individually controlled by front-panel rocker switches. An overall on/off switch and a switch to disable the warning beeper complete the controls.

Even when not on battery

power, the UPS-3160P protects your computer using three metal-oxide varistors as surge protectors and an EMI filter built into the power input jack. The system is doubly fused—input power on the rear panel, battery power inside the steel case.

Overall, the construction of the UPS-3160P is very good, earning the unit an Underwriters Laboratories (UL) rating. If you're willing to ignore that the UPS-3160P is actually a standby system, it can be an excellent source of power protection.

List Price: Taesung UPS-3160P, \$395. Taesung Industries Inc., 2001 Westside Pkwy., #240, Alpharetta, GA 30201; (404) 664-8944.

CIRCLE 440 ON READER SERVICE CARD

DoubleCOM: Simplifies Linking Serial Devices to Your PC

HANDS ON
by Robert Kane

Struggling with complex wiring schemes to connect more than two serial devices to a PC is hardly anyone's idea of a good time. But if you've given up on deciphering the mysteries of A/B switch boxes and are resigned to switching connections by hand, you now have a way out. DG Electronic Developments has simplified the task of connecting multiple serial devices to your PC with DoubleCOM: an integrated serial port/electronic A/B switch. Best of all, you can configure DoubleCOM: to work with any software package that your PC uses.

The DoubleCOM: package includes a half-length 8-bit board that sports a standard 8250 serial controller, two jumpers, two DB-9 male ports, a three-position toggle switch, a DB-9-to-DB-25 adapter cable, an installation disk; and documentation. Installation is easy for both novices and experts, requiring that you set the jumpers for the COM port to be used as well as the IRQ, and then pop the board into your computer. If

you are unsure of how to set these jumpers, the DoubleCOM: installation program will examine your computer's current configuration and graphically depict how to set the jumpers on the card.

There are several ways that you can switch between the two ports on the card. The easiest is by using the SWPORTR.COM program, a TSR that allows you to define hotkeys for switching between the two ports. This program also sets the appropriate parameters for the device on a particular port, making the use of the DOS MODE command unnecessary.

If the TSR conflicts with some of your software, you can use DoubleCOM: 's command-line utility, SWPORTC1.EXE, to switch ports. With this utility, you specify the port and the appropriate parameters for that port before calling an application. You can put these settings into a batch file that first switches to the device needed by an application, next sets the port parameters, and then invokes that application.

DG Electronic Developments also provides a utility that allows you to use the Double-

COM: board in the Microsoft Windows environment. When invoking this utility, you must confirm the parameters for each port and then the utility turns into an icon that indicates which port on the DoubleCOM: card is active. To switch ports, simply click on the icon and the new port becomes highlighted.

If all else fails, there is still the three-position toggle switch on the back of the DoubleCOM: card. This switch allows you to manually select either port A or B or the software selection of the ports (the middle position).

DoubleCOM: eliminates the need for an external A/B switch box. It does not require any additional cabling other than a cable for the specific device you are hooking to your PC, eliminating the need to figure out a cabling scheme for an external A/B switch. Priced about the same as an external A/B switch box, DoubleCOM: makes dealing with multiple serial devices as easy as A/B. ■

List Price: DoubleCOM:, \$149. DG Electronic Developments, 700 S. Armstrong, Denison, TX 75020; (214) 465-7805.

CIRCLE 441 ON READER SERVICE CARD

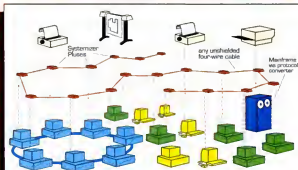
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Systemizing has become the connectivity standard at many of the world's largest corporations and throughout the federal government. Ten's of thousands are already in use. The new Systemizer Plus is the latest model in Applied Creative Technology's line of Systemizing products, and it delivers what 95% of corporate computer users want from a Local Area Network—at far less cost and complexity, and yet with much more versatility.

CIRCLE 477 ON READER SERVICE CARD

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First Looks

Springboard Publisher: A Taste of DTP, Not a Main Course

HANDS ON
by Lulse Simone

Low-end desktop publishing products find themselves in an unenviable position: if they're easy to use, they often do not deliver high-quality output. With *Springboard Publisher*, a \$129.95 program that competes with products like *PFS:First Publisher* and *PubliStar II*, Springboard Software tries to prove that ease-of-use and good-looking documents are not mutually exclusive.

Running under *Microsoft Windows*, *Springboard Publisher* is a down-and-dirty layout tool that allows novice desktop publishers to set up the overall structure of a document in minutes. The program's design strategy involves overlapping text and graphics frames; almost any size, shape, and arrangement is possible. Each frame can have different margin and column settings, and text automatically reflows within each frame to accommodate layout changes.

In addition, one story can automatically flow from page to page. You cannot establish text links between frames, however. To jump a story to another text frame, you must manually cut and paste the copy.

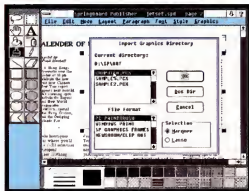
They had
budgeted
200 a day
for the 2
weeks. It
wasn't
enough.

Springboard Publisher's screen fonts (left) differ radically from resident HP LaserJet Series II fonts.

Beginners will find the program's text-handling features to be adequate. *Springboard Publisher* imports *Microsoft Word*, *WordPerfect*, *MultiMate*, and

page, the program redraws the remainder of the text.

Other functions also make *Springboard Publisher* easy to use. For example, it was a snap to type in the date, volume number, and logo line of the PC Labs sample newsletter using the tab settings. The number of rules and frame borders at your disposal is limited, but the tools themselves are foolproof. And a dialogue box that pops up when you import a graphic, allowing you to preview the contents of a file that contains multiple im-



In graphics mode, *Springboard Publisher* lets you preview a .PCX image before you import it.

ASCII files. When you turn off the automatic text formatting, you are left with a limited but speedy editor. The program cheats a little in order to attain fast screen response by graying out the text below your entry point. This is not a real hardship, since you need to read only what you are actually typing. When you reformat the

pages and to cut and paste only the one you want into your document, will be of help to anyone who uses clip-art libraries.

Despite these useful features, *Springboard Publisher* is limited in ways common to low-end DTP products. For example, the program will not automatically hyphenate words, will not allow global formatting changes, and will accept only low-resolution bitmapped images. In order to make high-quality typefaces available for printing, you must use *Springboard Publisher's* font substitution feature, which allows you to take advantage of either resident printer fonts or downloadable soft fonts. However, you cannot see those substituted fonts on-screen. Even if a downloadable font comes with screen equivalents, *Springboard Publisher* cannot display them. Using this feature while you are designing a document

ensures that you will see accurate line breaks, but it will be nearly impossible for you to read what is being displayed on-screen. Without using the font substitution feature, you are stuck with a maximum point size of 72 points and a maximum resolution of 72 dpi.

Springboard Publisher does deliver extra value by including a point program that duplicates and augments the functions of *Microsoft Paint* as well as making available such special effects as skewing, rotating, and inverting bitmapped images. But there is a hitch: Restricted to 72 dpi, images develop serious jagged edges and other distortions when you manipulate them using these special effects. *Springboard Publisher* also lacks the ability to make graphics backgrounds transparent, a feature that would help create a tighter fit between words and images across overlapping text and graphics frames.

Springboard Publisher would be a stronger program if it took better advantage of the *Windows* environment by supporting high-quality laser fonts and importing high-resolution TIFF files or vector-based graphics. Until then, it may be of most interest to beginners who want to get a taste of desktop publishing before plunging into *PageMaker*.



FACT FILE

Springboard Publisher
Springboard Software Inc.,
7808 Creekside Circle,
Minneapolis, MN 55435; (800)
445-4780.
List Price: \$129.95, including a
runtime version of *Microsoft*
Windows.
Requires: 640K RAM, hard
disk, mouse, *Microsoft*
Windows, DOS 2.0 or later.
Storage requirements: 1MB if
Windows is installed
separately, 3MB with the
runtime version of *Windows*.
In Short: A low-end DTP
program that has the potential
to be a great tool for beginners
but is limited by printing at
a maximum output resolution of
72 dots per inch, accepting only
bitmapped images, and
supplying only screen fonts.

CIRCLE 431 ON READER SERVICE CARD

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Bill Howard, Executive Editor
PC Magazine, December 27, 1988

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Hardware Compatibility—Regular Version: All IBM® PC, AT® PS/2® and compatibles with 256K RAM and DOS 2.0 or higher. All printers. All monitors.
Hardware Compatibility—DeskMate Version: Tandy 1000 SL with 384K RAM or IBM PC, AT, PS/2, and compatible computers with 512K RAM and DOS 2.0 or higher. All printers. All monitors (monochrome monitors require a Hercules or compatible graphics card). Also available for Macintosh and Apple II.
Capacity: Unlimited number of bank accounts. Unlimited number of transactions. Maximum amounts to \$9,999,999.99.
Other: Unlimited FREE technical support. Not copy-protected. Checks are pre-approved by all financial institutions in the U.S. and Canada. Sample checks and order form are enclosed in Quicken package.

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First Looks

Laser Manager: Smart Printing for Dumb Applications

HANDS ON
by Edward Mendelson

You brought that shiny new laser printer back to the office and found that your dusty old applications don't know how to use it. Laserpoint's \$99.95 *Laser Manager* won't make old applications any younger, but its printer-control menu and built-in fonts give your applications a chance to print better-looking spreadsheets and reports than they ever could before.

Laser Manager earns its keep when used with pre-LaserJet versions of dBASE, Lotus 1-2-3, and similar programs. Newer applications won't need it. When you run *Laser Manager*, it configures the printer to use the page size and font that you specify and downloads any soft fonts that you will need when printing. Unlike other printer managers, it doesn't install itself as a pop-up program, so you have to decide on the formats and fonts you want before entering your applications.

The program comes with well-designed Prestige and Times Roman fonts, including fixed-width versions of Times Roman that you can use for printing columnar data in spreadsheets. The fonts use a special character set that lets you construct simple graphics using the ordinary keyboard. When you type square brackets or curly braces, you get the box corners; other little-used keys produce lines and bullets. Optional disks with proportional and fixed-width versions of Helvetica and Optima cost \$59.95 each. Any of these fonts and graphics can be used for printing envelopes and labels

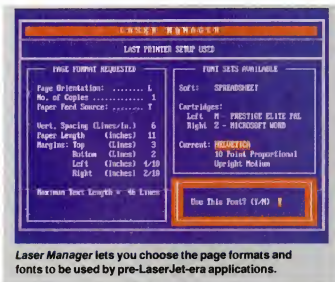
from the program's address database.

Laser Manager makes you jump through a lot of confusing menus to set it up and makes you walk through a shorter series of menus every time you use it. If you want good-looking output from old applications, this program can do the job. But you'll have a much easier time if you update your applications

and buy some standard soft fonts instead.

List Price: *Laser Manager*, \$99.95; additional font disks, \$59.95 each. **Requires:** 512K RAM, hard disk, HP LaserJet Series II or compatible printer, DOS 3.0 or later. **Laserpoint Corp.**, 98 Main St., #239, Tiburon, CA 94920; (800) 835-2246, ext. 208; (415) 389-8940.

CIRCLE 432 ON READER SERVICE CARD



Laser Manager lets you choose the page formats and fonts to be used by pre-LaserJet-era applications.

The Boredom-free Approach To Formatting Disks

HANDS ON
by Edward Mendelson

The most tedious sight you'll ever see on a computer screen is the head and track numbers of a disk being formatted. Sydex's \$15 *Con>Format* takes some of the monotony out of computing by formatting disks while you get some work done.

Con>Format loads into memory as a TSR, where it occupies 11K of RAM. When you press a hotkey, a window pops up and asks you the capacity of the disk you want to format. Press Enter, and formatting occurs in the background.

You can format disks on internal or external drives and in any standard DOS format. The choice of hotkeys includes combinations arcane enough to avoid conflicts with any other program. And you won't notice any sluggishness in your fore-

ground application while formatting is taking place.

Con>Format won't pop up over graphics screens, although it will continue a format begun before you entered a graphics program. It won't let programs write to a floppy disk until it's finished formatting, but it normally lets any other work continue uninterrupted. When used in combination with some disk caches, it won't let you enter or exit an application until it finishes formatting, but that's an error appropriately on the side of caution.

List Price: *Con>Format*, \$15 registration fee when downloaded from a BBS, PC MagNet, or CompuServe; \$50 for commercial use or site license. **Requires:** 11K RAM, DOS 2.0 or later. Sydex, 153 N. Murphy Ave., Sunnyvale, CA 94086; (408) 739-4386.

CIRCLE 433 ON READER SERVICE CARD

New Storage Space for Hard Disks

HANDS ON
by Edward Mendelson

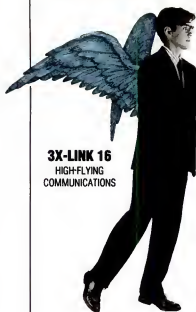
Sundog Software's \$99.95 *Squish Plus* utility lets you cordoned off part of your hard disk as storage space for compressed files. The cordoned-off area looks to you and DOS like an extra disk drive, but any file written to this imaginary disk drive is automatically compressed by *Squish Plus*. The program squeezes database files to as little as one-tenth their normal size; text and spreadsheet files go down to from half to two-thirds of normal. When you call up the compressed file for use with an application or copy it to another disk, *Squish Plus* decompresses it on the fly.

Squish Plus runs so quickly on AT or faster machines that you probably won't notice the time lost in compressing or decompressing files. You can lock the *Squish Plus* "disk" with a password, but in all other ways, the disk acts enough like a DOS disk that you can use any standard set of DOS utilities to restore accidentally deleted files.

There's always a price for this kind of convenience. *Squish Plus* gobbles up 37K of RAM and has quirks that can cause you to lose data. If you try to copy a file to a *Squish Plus* "drive" when it's too large to fit, you get an error message followed by DOS's familiar "Abort, Retry, Ignore, Fail?" You can only escape by choosing Abort or Fail, and the file won't be copied, so you'll know you should make room for it. But if you press Ignore before choosing Abort, part of the file will get copied, and you won't know what happened to the part that wasn't copied.

List Price: *Squish Plus*, \$99.95. **Requires:** 37K RAM, hard disk, DOS 2.0 or later. Sundog Software Corp., 264 Court St., Brooklyn, NY 11231.

CIRCLE 434 ON READER SERVICE CARD



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HIGH-FLYING
COMMUNICATIONS

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In just seconds, you'll be transferring files in full **background mode**! No need to interrupt your current program. And no need to interrupt your business as you install (and maintain) an expensive network. You can even transfer files automatically, using our auto-script feature.

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And our optional 3X-Spool16 intelligent printer spooling software lets you share connected printers (up to 16), automatically managing paper sizes all without waiting. And without buying limited, expensive printer sharing boxes.

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What's more, our built-in E-Mail feature lets you send messages in background mode, no extra E-Mail software required.

The choice is yours :

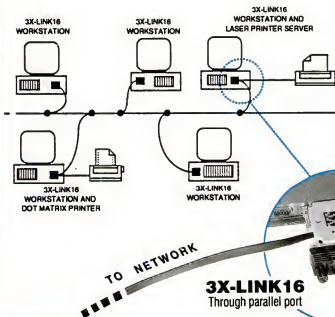
3X-LINK16 comes complete with 3 1/2" and 5 1/4" software diskettes, parallel connectors, and a 12 foot cable... all you need to connect two PCs for only \$239. Additional stations can be added for \$139 each. 3X spool16, our printer sharing software option, can be added for only \$149.

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- *LIM EMS VERSION 4.0 DRIVER INCLUDED
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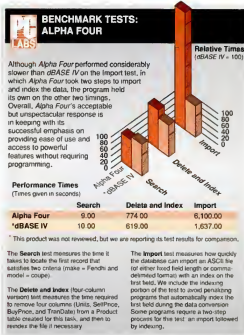
First Looks

Alpha Four Combines Relational Power and Flat-File Simplicity

HANDS ON
by Alfred Poor

Alpha Software Corp. has taken its expertise at building easy-to-use flat-file database programs and applied it to the task of creating a nonprogrammable relational DBMS that reads and writes *dBASE III Plus* files. The result is *Alpha Four*, a \$549 program that is a big step up from flat-file managers, but that also makes it incredibly easy to tap its multiple-file capabilities.

Alpha Four is entirely menu driven, offering you choices that are easily understood and well organized. Default settings are adequate for handling simple database tasks and can be changed to execute those that are more complex. You can almost always pop up a window



tables, but it really shines when it comes to handling a batch of related tables. The only drawback to using *Alpha Four* as a flat-file manager is that, like

forms, as well as multiple indices, which can be built on multiple fields. You can use existing .DBF files or, of course, create new data files.

When you create a SET, you can work with a group of tables at one time. You create a definition that shows how the tables are related, and then specify what the common field is among them. Not only will the program alert you if the new table isn't indexed, it won't let you continue until you have created the requisite index.

Once you've designed a SET, it's easy to use the fields from all related tables in many ways. For example, you can create lookup fields that report on the contents of records in the related table, and you can select the related fields from pop-up lists. With *dBASE III Plus*, you would have to write perhaps a page or two of @ SAY/GET statements and a bunch of SELECT and SET RELATION TO statements to achieve the same results.

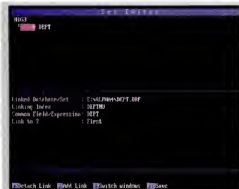
Alpha Four's report generator has a number of impressive

features, some of which might convince *dBASE* users to use the program just for these alone. In addition to a well-designed visual layout of report sections, the program offers plenty of field formatting and calculating options. For example, you can set a field for preprocessing, causing a report to run through one or more preliminary passes to calculate totals and other summary figures, and then use those numbers in calculations in the report. This requires no programming, which really sets the program apart from much of its competition.

Other noteworthy features include customizable menus, sophisticated data-entry and edit-mask functions, and a host of supported importable and exportable data file formats. A comprehensive reference manual and thorough printed tutorial accompany the program.

Alpha Four isn't without its limitations, however. For one, it cannot import data into an existing table. You must bring it into a separate table created as part of the import process, then copy the records from one table to another. Then too, you can add color to data screens, but only to fields, not to prompts. Finally, some of the program's processing operations are slower than those of *dBASE III Plus*.

Even with these limitations, *Alpha Four* is a very attractive package, offering a lot more functionality than a flat-file manager and a lot more simplicity than a programmable relational DBMS.



Alpha Four SETs are combinations of data tables. Each record in HIG3 relates to a record in the DEPT table.

that lists current choices, and context-sensitive help is but a keystroke away.

The program performs admirably as a manager of single

dBASE III Plus, it limits you to only 128 fields per record, which you can easily overrun. The program does offer multiple custom data-entry and edit

PC FACT FILE

Alpha Four
Alpha Software Corp., 1 North
Ave., Burlington, MA 01803;
(800) 451-1018, (617) 229-
2524.
List Price: \$549
Requires: 512K RAM, one
floppy disk drive and a hard
disk, DOS 2.0 or later.
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relational database that makes
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New & Improved

News of Announced Products and Upgrades

GlobalView Monitors, Configures Remote Dial-Up Modems

NEW

If, despite an inability to be in more than one place at a time, you need to supervise a vast network of dial-up modems, **Universal Data Systems'** GlobalView can help relieve your burden by letting you remotely configure and monitor the modems from a centrally located AT compatible.

GlobalView consists of *Microsoft Windows*-based software and an RS-422 interface card, which resides within an 80286-based PC controller. The card connects to a Universal Data Shelf equipment rack that holds up to 32 devices, and each controller will support up to 16 racks. One controller can supervise a maximum of 512 local or remote modems.

Although remote-configuration capability is available only for certain UDS modems, you can remotely diagnose and monitor any rack-mount card, internal or external modem that adheres to a communications standard (such as V.32 or V.22bis).

The software allows you to manipulate system-configuration files, determine alarm criteria, control callback security, and generate network activity reports that you can export to a spreadsheet. In addition to testing remote modems, GlobalView gives a visual representation of each device on the network, graphically displaying status indicators and configuration. The program's system map allows you to view network devices according to address, device type, active or inactive status, and unassigned positions.

You can also annotate the status screens with data such as the modem's phone number, the relevant contact's name and address, and the address of the remote location.

List Price: GlobalView (software, one rack, one modem, and adapter) \$6,000.
Requires: 80286- or 80386-based system, 640K RAM, graphics adapter, DOS 3.0 or later. The package includes a runtime version of *Microsoft Windows*, Universal Data Systems, 5000 Bradford Dr., Huntsville, AL 35805; (206) 721-8000.

CIRCLE 444 ON READER SERVICE CARD

ATARI ENTERS PC MARKET WITH 1-POUND HANDHELD SYSTEMS

Atari's first step into the world of PC-compatibles leaves a tiny footprint: 7.8 by 4.1 by 1.2 inches, to be exact. The \$399 Atari Portfolio features a 4.92-MHz 80C88 processor, a 63-key QWERTY keyboard, and a 40-column by 8-line screen. It runs on two AA batteries that can last from 4 to 6 weeks, depending upon intensity of use.

Rather than magnetic storage, the 1-pound Portfolio uses RAM and ROM cards. Standard configurations come with 128K RAM (expandable to 640K) and 256K of ROM that contains the BIOS, a DOS 2.11-compatible operating system, and seven menu-driven software applications. Memory cards are available in 32K and 128K RAM denominations; ROM can be expanded up to 4MB.

Built-in applications include a rudimentary word processor, *Lotus 1-2-3*-compatible spreadsheet, address book, and scheduler. Other applications will be available on ROM cards. The 240- by 64-pixel LCD display uses overlapping windows for viewing 80-column screens. You can transfer data through the machine's serial or parallel port.

List Price: Atari Portfolio, \$399. Atari Computer, 1196 Borregas Ave., P.O. Box 3427, Sunnyvale, CA 94088; (408) 745-2000.

CIRCLE 443 ON READER SERVICE CARD



Atari uses RAM and ROM cards to make the Portfolio a less weighty machine.

Ricoh's Copier, Scanner, Fax Keep Your Laptop Company

NEW



Ricoh's MC50 copier and IM-A scanner controller let you control scanning through software or hardware.

When traveling on business, it's rare that one leaves behind the desire for the amenities of modern office life, such as the photocopy machine around the corner and the fax machine down the corridor. Ricoh's 3-pound MC50

copier, 1-pound IM-A scanner interface, and 2-pound IM-F50 fax interface mean that you need never be without these conveniences.

The \$540 Ricoh MC50 copier, which replicates 4- by 6-inch images at 200-dot-per-inch resolution on thermal paper, plain paper,

CONTINUES ON PAGE 54

New & Improved

RICOH MC50

CONTINUES FROM PAGE 53

or transparencies, represents the hub of Ricoh's Portable Digital Information System (PDIS).

When connected to the \$510 Ricoh IM-A scanner interface, the MC50 becomes a scanner with capabilities that include enlarging, reducing, reversing, and dithering images. You can reduce a picture to 50, 70, or 80 percent of its original size or enlarge it by 120, 140, 160, or 200 percent. The IM-A dithers with up to 16 gray shades.

If hooked up to the RS-232 port of a PC, the IM-A's software lets you display scanned images and save them to disk in file formats such as TIFF and GEM. To send or receive a fax you can plug the \$540 Ricoh IM-F50 transceiver into the MC50; the transceiver is Group III compatible and transfers data at 4,800 bits per second through an RJ-11 jack. An 8½- by 11-inch document is automatically reduced to 4 by 6 inches upon receipt; the reverse occurs when sending a 4- by 6-inch fax.

All the PDIS devices operate on rechargeable nickel cadmium batteries or 120-volt AC power.

List Price: Ricoh MC50, \$540; Ricoh IM-A, \$510; Ricoh IM-F50, \$540. **Cables Included.** Ricoh Consumer Products Group, 155 Passaic Ave., Fairfield, NJ 07006; (201) 882-6464.

CIRCLE 448 ON READER SERVICE CARD

SentinelShell Guards Against Software Piracy

NEW

Now that most business software comes without copy protection, it has become increasingly difficult to prevent bootlegging within large organizations. To help preserve the sanctity of the copyright agreement as well as unauthorized use of software, the \$75 SentinelShell from Rainbow Technologies allows you to build a copy-protected shell around any off-the-shelf application software.

With the SentinelShell's software, you create a shell that automatically checks your



The SentinelShell lets you copy-protect off-the-shelf software.

parallel port for the package's hardware key. Any subsequent copies made of the application will require the hardware key to run. The key feeds parallel port data through to whatever peripheral you've attached to it.

List Price: SentinelShell, \$75. **Requires:** Parallel port. Rainbow Technologies Inc., 18011-A Mitchell South, Irvine, CA 92714; (714) 261-0228.

CIRCLE 449 ON READER SERVICE CARD

IMPROVED

by Elisa Hirsch

Micrografx Designer, Version 2.0—The new version of *Micrografx Designer* runs under the OS/2 Presentation Manager. *Micrografx Designer* 2.0 now includes automatic color-gradient fills, auto-trace, bezier-curve editing, and a freehand drawing tool. Import and export filters for .PCX, .TIF, .CGM, and .DXF files have also been added. In addition, the new version has spot-color- and process-color-separation capabilities. The upgrade to *Designer* 2.0 is free for *Micrografx ETSS* subscribers and anyone who purchased *Micrografx Designer* after February 1, 1989. Other registered users can upgrade to Version 2.0 for \$99. New packages retail for \$695. *Micrografx Inc.*, Richardson, Tex.; (800) 272-3729.

PC MagNet—*PC Magazine's* interactive on-line service, PC MagNet, has merged two forums and added another. The Tips & Techniques forum and the Utilities forum were merged to create a single area to discuss all of the magazine's Productivity columns. You can reach the consolidated forum by entering either GO TIPS or GO UTILFORUM from any prompt. The new forum, After Hours, concentrates on leisure activities, ranging from games to opera, from science fiction to politics. See page 8 for information on joining PC MagNet.

Microsoft Programmer's Library, Version 1.1—The CD-ROM productivity tool now includes 72 books and manuals and more sample code. Version 1.1 comes with a three-user license and includes a three-user version of OPTINET*, which allows up to three users to access a single disk. The upgrade



Micrografx Designer 2.0 now performs color and gray-scale gradient fills.

is free to registered owners of Version 1.0, new packages retail for \$395. Additional nodes cost \$65 each. *Microsoft Corp.*, Redmond, Wash.; (206) 882-8080.

PFS:First Publisher, Version 2.1—Software Publishing Corp.'s *PFS:First Publisher* entry-level desktop publishing package now supports Bitstream fonts and *WordPerfect* 5.0, according to the company. *PFS:First Publisher* 2.1 also includes VGA support for *SNAPSHOT*, a screen-image-capturing program. Upgrades are available to registered Version 2.0 users for \$15 and to Version 1.0 users for \$35. New packages of Version 2.1 retail for \$129. *Software Publishing Corp.*, Mountain View, Calif.; (415) 962-8910.

MultiMate Advantage II—The Ashton-Tate Corp. has released a Printer Enhancement Pack (PEP) for use with *MultiMate Advantage II*. The new package offers menu-driven printer and font selection as well as WYSIWYG page preview. It also supports Hewlett-Packard and compatible laser printers. Ashton-Tate is offering a \$65 upgrade price to users of previous versions for conversion to *MultiMate Advantage II*, which includes PEP. New packages of PEP retail for \$30. *Ashton-Tate Corp.*, Torrance, Calif.; (203) 289-6300.

Blaise Computing Updates Its Tools—Blaise Computing announces *Turbo C Tools* 2.0 and *Power Tools Plus* 5.0. Both programs now feature *The Norton Guides Instant Access Program* and an on-line database of reference information for their respective functions. *Turbo C Tools* 2.0 also provides enhanced mouse movement detection and multiple-line edit fields with configurable edit keys. The upgraded version of *Power Tools Plus*, designed to enhance *Turbo Pascal* 5.0, offers "pick" windows and the ability to

CONTINUES ON PAGE 56

Be Objective.

Turbo Pascal,* the world-standard Pascal compiler, adds Object-Oriented Programming with our new version 5.5. We combined the simplicity of Apple's Object Pascal language with the power and efficiency of C++ to create Turbo Pascal 5.5, the object-oriented programming language for the rest of us.

It's easy to extend yourself

If you're already programming with Turbo Pascal, it's easy to extend yourself from structured programming to object-oriented programming. And, Turbo Pascal 5.5 is the *only* compiler that is 100% source-code compatible with your existing Turbo Pascal 4.0 and 5.0 programs.

A fast object lesson

Object-oriented application programs more closely model the way you think. Objects contain both data and code.

As in a spreadsheet cell, the value and the formula are together. Objects can *inherit* properties from other objects. For example, a Porsche Carrera inherits most

attributes from the base model 911, but it also sports a whale tail.

Turbo Pascal 5.5's object-oriented extensions give you code that's easier to change, extend, and support.

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Inheritance provides powerful modeling capabilities by allowing objects to inherit attributes from other objects.

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CIRCLE 157 ON READER SERVICE CARD

Best Cache For Little Cash

Even if your computer has a memory cache, disk caching can double or triple your system performance for only \$79.95. Read what the editors of PC Magazine say about Multisoft's products in the February 14, 1989 issue.

PC EDITOR'S
CHOICE

• Super PC-Kwik

Speed is the only reason to use a disk cache, but speed isn't the only criterion to use in choosing one. The best cache program is the one that speeds up disk activity while occupying the least DOS memory and adapting to the special requirements of your work and your computer.

Super PC-Kwik is the fastest cache program available, and it's also the one with the most useful and sensible options. You can squeeze it down to as little as 9K of RAM and still maintain a half-megabyte cache in expanded memory. You can also benefit from its speed and intelligence if you keep the cache in conventional or extended memory.

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New & Improved

Mouse Integrates Numeric Keypad, Programmable Keys

NEW

Many people feel that because they input data via the keyboard, a mouse hinders rather than enhances their productivity. The PowerMouse 100, from ProHance Technologies, lets users have the best of both worlds: it integrates a two-button mouse with 40 programmable keys, keys preprogrammed with widely used spreadsheet functions, and a numeric keypad.

You define the attributes of the \$195 PowerMouse 100's keys within a key-definition table—you can have an unlimited number of definition tables. The PowerMouse 100 comes with preprogrammed functions for Lotus 1-2-3 and other spreadsheet packages. Predefined functions include programming statements, TSR hotkeys, and macros (such as copying, erasing, and range formatting).

The mouse works with applications that do not have existing mouse support as well as those that support two-button mice, according to the company. It comes with drivers and software to configure it for use with software such as word processors, databases, and desktop publishing programs. Featuring BIOS-compatible Microsoft Mouse emulation, the PowerMouse uses opto-mechanical



The PowerMouse 100 lets you perform common spreadsheet tasks such as copying ranges and summing cells, without forcing you to constantly jump from the mouse to the keyboard.

technology and interfaces with your RS-232 port (the package includes a 9- to 25-pin adapter) at a user-selectable speed of between 1,200 and 38,400 bits per second.

List Price: PowerMouse 100, \$195.

Requires: 20K RAM, DOS 2.0 or later, graphics adapter, serial port. ProHance Technologies Inc., 1558 Siesta Dr., Los Altos, CA 94022; (415) 967-5679, (800) 345-9111, ext. 18.

CIRCLE 147 ON READER SERVICE CARD

IMPROVED

CONTINUED FROM PAGE 54

generate context-sensitive help screens. Turbo C Tools 2.0 and Power Tools Plus 5.0 retail for \$149 each. Blaise Computing Inc., Berkeley, Calif.; (415) 540-5441.

Streets on a Disk, Version 3.0—The Streets on a Disk package now includes an AutoPlace command, which will read a list of addresses and automatically position them on a map. The new version supports detailed maps with up to 1/2 million street segments and includes up to 16 different types of streets. Travel routes can be mapped with an AutoRoute command that subtotals travel stops. Version 3.0 now has a Masterfile series, which features large, detailed maps for major areas. Version 2.0 users can upgrade the main package by sending their original disks #1 and #2 and \$35 to the vendor. Spot maps can be upgraded for \$5. New base packages retail for \$150. New spot maps packages range from \$20 to \$640. Klynas Engineering, Simi Valley, Calif.; (805) 583-1029.



A sample Streets on a Disk map of Marina del Rey, California.

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See it, do it

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Reflex 2.0 is only \$249.95

Reflex 2.0 at \$249.95 is a true value. If you deal with *any* kind of lists or data, and you want to see what it all means, you need Reflex 2.0.

To order a Trial Version (\$9.95) or to upgrade from previous versions (\$75.00), call 1-800-426-7526.

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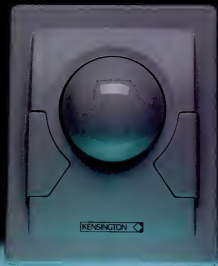
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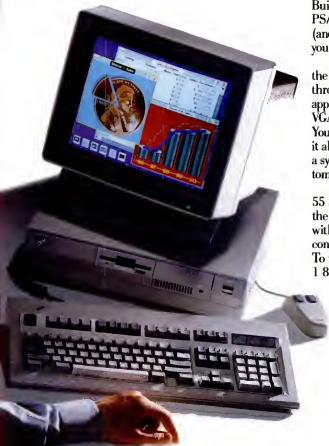


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Central Point Software^{INC.}
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by
Gus Venditto

Pipeline

A look at the trends shaping the personal computer

Battle Shaping Up for Recreational On-line Services

Just as Prodigy starts to reach critical mass in its experiment to change the way Americans use computers, other big corporations are starting to vie for position in the on-line services market.

In April, AT&T filed a motion with Federal District Judge Harold Greene, requesting permission to use

on-line networks to publish information. In the landmark 1982 telecommunications divestiture decision that Greene wrote, AT&T was barred from electronic publishing for at least 7 years. At the time, Greene said he would consider lifting the ban after 7 years, a period that the judge felt would give other potential publishers

a chance to build their own networks.

Several days later, Nynex, the Northeastern regional phone company that also owns a chain of retail computer stores, announced it would operate an on-line service offering text from about 50 newspapers, including *USA Today*.

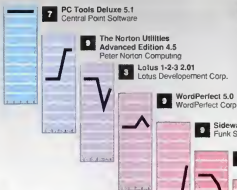
Nynex is already publishing phone directories, both white and yellow pages, on CD-ROM disks, but as part of the landmark 1982 AT&T

divestiture, regional phone companies were banned from using on-line services to publish information. They can, however, act as the conduit for data derived from other sources.

AT&T would like to do both: maintain the network and publish original information. And, before long, the Baby Bells will probably try to follow suit.

In past years, many have been attracted to the potential of creating an on-line service.

CONTINUED ON PAGE 64



READING THE CHART

The Top Ten Sellers list ranks PC business programs according to their sales totals in the week ending April 15. The chart that appears to the left of each program's name shows how the program's sales ranked each week for 5 weeks. The hash marks at the bottom of each chart represent each of those 5 weeks, beginning with the week of March 13. Dramatic shifts in a particular program's ranking may be the result of seasonal factors or sales promotions conducted by individual retailers. More than 12,000 individual locations contribute to the list.

Sales information compiled by Ingram Software Inc. and PC Connection Inc. Rankings are based on net sales by unit; returns are subtracted from gross sales.

TOP TEN SELLERS—A 5-Week History

Utilities dominated sales in recent weeks. The new version of *PC Tools Deluxe* has been the top seller since it was released, and that's an especially impressive performance in light of the large installed base that is updating its current version, not buying a new copy in the stores.

At the same time, arch-rival *The Norton Utilities Advanced Edition* is selling almost as well, without benefit of a recent upgrade.

And Funk Software's *Sideways* continues its strength, in spite of the free copy of *Always* that Lotus is now supplying with each copy of *Lotus 1-2-3*. *Always* is an excellent product for laser printers, but *Sideways* is needed for printing worksheets on a dot matrix printer.

Pipeline

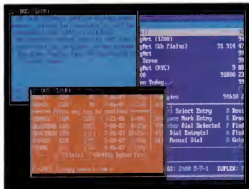
CONTINUED FROM PAGE 63

The Knight-Ridder newspaper chain tried and failed. The Source built up a large user base but has recently cut back services.

Only H. R. Block's CompuServe, with more than 500,000 users, has succeeded in building a broad-based information network. (PC Magazine runs its own online service, PC MagNet, from within CompuServe's network.)

Prodigy is now opening its wide-ranging system at the rate of one new city every month. New York went live in June, joining Los Angeles, San Francisco, Detroit, Philadelphia, Houston, Atlanta, and Washington, D.C. By the end of the year, the service will be available to more than 40 percent of U.S. households. Prodigy estimates that there are about 9 million homes with compatible systems (PCs with Hercules or CGA-standard graphics).

In its first year, Prodigy



A DESQview screen doesn't look that unique, but the multitasking technique that manages the display has been patented.

seems to have learned quite a bit by watching CompuServe's successful forums. When IBM and Sears began Prodigy last year, a variety of "ask the expert" services were offered, featuring personalities like Jane Fonda and Bob Vila. These have been phased out in favor of forums similar to CompuServe's where anyone can post a question and anyone can answer.

Prodigy still maintains a strong family orientation and is avoiding CompuServe's

business-oriented message. AT&T has yet to show its plans, but when it does, other players are sure to emerge.

Quarterdeck Sends Shockwaves Through Software Community

A recent announcement from the U.S. Patent Office protecting Quarterdeck Office Systems' DESQview caught software developers by surprise in April.

The multitasking technique was protected with a patent entitled "An Improved Display

System and Memory Architecture and Method for Displaying Images in Windows on a Video Display." The immediate reaction from some quarters was that this would change the future of windowing software.

A close reading of the patent, however, reveals that Quarterdeck's method has little relation to the techniques that Microsoft and IBM are using. Quarterdeck employs a "pseudo-buffer" to keep each application separate and then compares the contents of each against the visible screen before changing the display. The method lets DESQview display several applications without intervention by the operating system.

OS/2 and Unix, of course, give applications control over their own areas of the screen, without maintaining such buffers. So while Quarterdeck can be assured that no one will steal its method, it is not very likely that any major league software publishers will be paying royalties to the company.



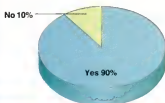
MAGNET SURVEY

The trends in add-in boards change almost yearly, with few exceptions. There's never enough memory in any machine, and the high prices of the last year have made that situation even worse.

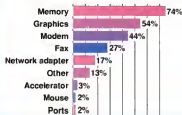
A recent PC MagNet poll shows that fax boards have

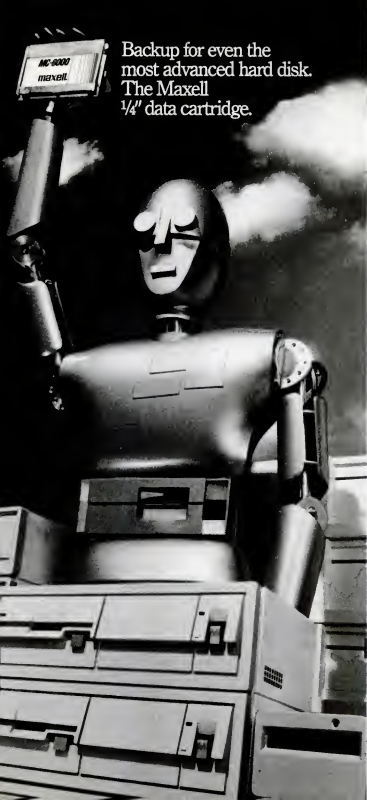
risen in popularity to roughly the place that accelerator boards held several years ago. And, of course, the need for additional ports has dropped dramatically, since more manufacturers are building serial and parallel connections into more machines.

Does your company plan to buy any add-in boards within the next 12 months?



Which type do you plan to buy?



A large, stylized robot with a metallic, somewhat abstract face and a body composed of various mechanical parts. It is holding a Maxell MC-6000 data cartridge in its right hand. The background is a cloudy sky.

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CIRCLE 112 ON READER SERVICE CARD

Bill Machrone



Remember Zorro? The dashing hero/criminal left his distinctive mark everywhere. His computer equivalent sometimes goes by the rather unexciting name of Sam.

I met a criminal the other day. He was in my office, demonstrating a new version of a popular software package. You might recognize his name; you'd definitely recognize the product. I'll protect the guilty, however, by not mentioning either one here. For the sake of conversation, we'll just call him Sam.

The criminal in question travels a lot. He carries a laptop computer everywhere, and telecommunication is essential to running his business. Like most of us with the same needs, he finds getting at the phone line essential. And many hotels still have hard-wired phones. He has traveled with the usual gadgetry, including a short RJ-11 cable that ends in a pair of alligator clips, and a screwdriver to take the phone apart. Like all of us, he has felt vaguely furtive as he's taken phones apart across the country. Closer to home, fellow columnist Jim Seymour has been known to delicately carve away the insulation on the phone wires in Red Carpet Clubs across the country. That way, he can get his telecommunicating done during those interminable waits for delayed flights. I've seen and used the product of his handiwork.

There's a hierarchy and a guiding principle in criminal behavior. Taking the phone apart probably violates some law. Carving away the insulation is clearly a form of willful destruction of property. But our star criminal Sam figured that he might as well be hung for a sheep as a lamb. He dispensed with the usual toolkit and re-equipped himself down at the local Radio Shack store. He bought the tool that cuts and strips phone wire and crimps RJ-11 connectors. Now when Sam encounters a phone system without RJ-11 connectors, he clips the line 6 or 8 inches behind the phone. He crimps RJ-11 male connectors to the two ends of the cables and plugs them into a double-female in-line connector to restore the connection. Then he can patch in conveniently during his stay without disemboweling the phone. When he leaves, his handiwork is there for all to see. Yes, the hotel actually gains a few dollars' worth of parts, but you can imagine what hotel management would say if you asked permission to perform the Sam conversion.

Sam may be a criminal, but he knows what he's doing. Most people have never looked

closely enough at an RJ-11 cable to know that there's a proper polarity. Sam gets it right. He also knows not to cut into the burgeoning numbers of digital PBXs or the occasional RJ-45 cable. The good news is that increasing numbers of hotels are providing data ports on their digital systems and upgrading older systems to RJ-11-based connectors. I'm sure there are good economic reasons for doing so, but I applaud the high-minded societal implications: good people like Sam won't have to be criminals anymore.

ON ANOTHER FRONT

The nineties are nearly upon us, and Tandy Corporation president John Roach has introduced the concept of the JEAN machine to his staff. It stands for John's Electronic Appliance of the Nineties. The idea is to build appliance-like hardware and software—stuff that doesn't need a manual or an instruction book. Tandy insiders, however, say it's just a bit of Texas



chauvinism: Roach's wife's name is Jean, and he's talking about building products that are simple enough that she'll really use them. Chauvinism aside, I think he's onto something. A lot of people I know are too practical to be bothered mastering the technogadget complexity masquerading as wizardry in most "advanced" products.

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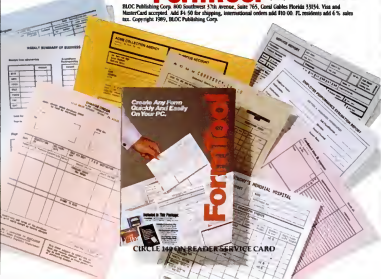
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CIRCLE 32 ON READER SERVICE CARD

Bill Machrone

a class of products that are nearly impenetrable. Word processors include many mostly unnecessary graphics features. Spreadsheets masquerade as databases. Databases include spreadsheetlike features. You'd think we'd have this issue resolved by now. Can a product that's feature-rich be easy to use? Can a product that's easy to use develop the kind of staying power necessary for big success?

All products have a learning curve, but some have a learning cliff. Virtually any product that has a programming language or macro facility also has a learning cliff. First you learn the see-Spot-run mode, then you grid yourself for battle as you learn the advanced features. Some products, such as *PageMaker*, have the complexity without a new mode. It's in the same menus, but it's a cliff nonetheless.

NO CREDIT

Then you have products such as *PFS:First Choice*, *Quicken*, and *Hot Line*. Every feature is there on the surface for all to see. These products get the job done for millions of people every day. But magazines don't say much about them.

A cynic might even say that there are two classes of product: the kind people use and the kind magazines write about. That isn't really true, but it suggests a bimodal distribution. High-end products have to be powerful enough to generate aftermarkets in training, add-ons, and third-party support. A high-end product actually *requires* the learning cliff to be successful. It needs a programming or macro language, or hooks for add-on software. And naturally that gives us something to talk about.

On the other end of the scale are the products that are so simple they don't require a manual—or you only read the manual once. They're ideal for people who just want to get a job done, or who use a PC infrequently enough that they don't want to relearn a product just to get their job done. They don't care about extra capabilities, expandability, or anything else. That's an interesting phenomenon, but not much grist for the editorial mill.

As brand specifiers, your job is to tell the difference between the two kinds of users and make sure they get the product that's right for them. Not all products will or should become JEANS, but the need for them is clear and will continue.

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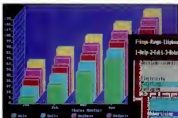


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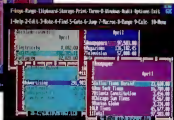
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John C. Dvorak



**Microsoft's OS/2
strategy is in
deep trouble.
But it's not too late
to fend off the
Unix hordes.**

It was depressing to see Bob Frankston, a guy who 2 years ago was high on OS/2, so down in the mouth. The *VisiCalc* co-inventor suspects that OS/2 might not make it after all. The threat is Unix and the bands of Unix hacks out there who, like relentless zombies, keep grinding out C programs designed to run under Unix.

Three active forces will doom OS/2 to the Dvorak Hall of Infamy if something doesn't happen fast. The first is the sheer number of coders in the colleges around the country who work in the Unix environment. The second is RISC mania. The RISC chip is coming on strong, and we can expect to see RISC machines from numerous vendors that run Unix because it's the easiest operating system to put on any machine. Thousands of applications already run on Unix. Thousands—not 30 or 40.

And then there is the third force: Sun Microsystems and its Unix guru, Bill Joy. Frankston admitted to me that many of his earlier complaints about Unix have been overcome by Bill Joy's inspired patches. On top of that, there are outstanding new Unix shells like Carnegie-Mellon's sexy MACH, used by Steve Jobs in his NeXT machine and nearly adopted by IBM for its next generation of RISC machines.

In short, the momentum behind Unix is so vast and overwhelming that it looks as if Bill Gates and his henchmen are fighting an uphill battle, even with IBM's support.

Recent sales figures for OS/2 are grim, doing nothing to encourage developers. According to IDC Research, 9.8 million DOS licenses were shipped worldwide during 1988. By comparison, a mere 65,000 copies of OS/2 were shipped, 53,000 of which were sold by IBM. One can assume that IBM itself, with its 400,000 employees, uses most of these licenses. Meanwhile, Microsoft has hired a new guy, Paul Maritz, to head up the OS/2 project, in an effort to turn it around. We wish him luck.

DVORAK'S FIVE POINTS

But OS/2 is not a dead dog yet. Here are my recommendations as to what Microsoft can do to make OS/2 the standard operating system of the 1990s.

Reengineer it so that it's not machine-dependent. As it now works, you cannot really

take OS/2 from one machine to another and boot it. I can take a copy of PC-DOS and boot it on either my 386 machine or my portable. This lets me check out each new version to see if I like it. Only IBM, Compaq, and the other biggies benefit from OS/2's machine-dependent design. It hurts small vendors, because people fear that they won't be able to update their systems if the vendor goes broke. So overall business suffers.

Sell it for \$60. I don't have to elaborate on the reasoning behind this strategy. Maybe the new-math geniuses at Microsoft figure that selling 65,000 copies at \$400 translates to more revenue than 9 million copies at \$60.

Put it in ROM. Users would love an instant-on version of any operating system. OS/2 would be the perfect place for Microsoft to make an impact with this idea.

Put some heavyweights on the project. The system software division at Microsoft supposedly numbers over 500. Let's face it, this is



ILLUSTRATION CATHY HILL

too many people. OS/2 is a camel of an operating system. Microsoft needs to find some superstars and put them to work.

Stop hedging and bet the company. If OS/2 is so great, then why did Microsoft buy into SCO and Unix? Why is it continuing to upgrade DOS? Microsoft's lack of total commitment is sensed by the user community, and it translates into a wait-and-see attitude.

So . . . we'll wait and see. ■



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Inside Track

It was 90 degrees in California when I left for Spring Comdex. When I arrived in Chicago, it was 36 degrees at O'Hare and had just snowed. Like I was really going to enjoy this show, huh?

Not that it was a cold dog of a show. The show was OK. What was bad was the weather and the site: the **hopeless and ungainly McCormick Place**, a grim facility that only Darth Vader could like. A place desperately in need of moving sidewalks and people shuttles.

To amplify the miserable aspects of this hellhole, the show was divided between two halls. To get from one to the other, you had to go through a rat's maze of underground and enclosed tunnels. You'd go up an escalator, down a long hall, down an escalator, down another long hall, up some stairs, down another long hall, down some stairs, up, down, left, right, and so on. By the time you got to where you were going, you had forgotten why you were going there, you felt as if you had just done a scene from the movie *Brazil*, and you were pooped. You could wander the dark mazes crisscrossing these halls for hours without ever seeing an exhibit.

In the North Hall was a "new" show called **MacDex**, supposed to be a mini-Comdex for Macintosh products. While it may once have seemed like a good idea to somebody, folks, you'll **never see this event again**. If I were a vendor who got suckered into exhibiting at this pathetic sideshow, I'd ask for my money back. Nobody went there. Simply put, it was a fiasco.

The talk of the real show was the **introduction of the 80486** at the same time a slew of vendors were showing computers based on the legendary 33-MHz 386. I thought that was amusing.

If there was an ominous theme, it was the sudden appearance of large, active-matrix color LCD screens. Toshiba had an 11-inch VGA model that took your breath away. Mitsubishi had one running in a laptop that was enclosed in a Lucite cabinet surrounded by guards. I guess they didn't want anyone to get a good look at it.

Sharp had a large color LCD in a clunky, elongated lunchbox portable, also in a Lucite display case. The Sharp showed screen burn and was the least appealing of the three displays. Zenith was there with a 6-inch Hitachi color screen running in one of its 386 portables. NEC and Compaq chose not to attend the show, so who knows where they stand? It's obvious that we are only a few years away from **spectacular color laptop computers**. Hold onto your hats.

The Most Interesting Things at the Show Dept.: Let's

MacDex: If I were a vendor who got suckered into this pathetic sideshow, I'd ask for my money back.

start with PFIDO (Printer-Fax-Input Device with Output), the new portable printer/scanner from Holmes

Microsystems of Salt Lake City (801) 975-9929). It plugs directly into a Holmes Fax'Em card (a combination 4,800-bit-per-second fax and 2,400-bps modem card for use with all the top laptops; Holmes showed me a **9,600-bps** version to ship this summer). Anyway, this PFIDO doohickey can scan a **complete page** and also contains a thermal printer for printing faxes or documents from your laptop. Holmes doesn't know

what this is going to cost, but the whole setup seems like something from "**Mission Impossible**." It's hot, and so is Holmes. I thought it was the highlight of the show.

Meanwhile, over in the grim MacDex show, I ran into a crossover Mac/PC product called **Fastkeys**. It's from SoundSight Corp. (2105 Alcyona Dr., Los Angeles, CA 90068; (213) 463-9464). This is a **wild** little touch-sensitive glue-on strip that you attach to the side of a mouse to add various keyboard functions. Imagine that—you can now have a delete key along the side of your mouse! Six keys can be used for various functions; you can cut and paste like never before.

You have to fiddle with your keyboard's innards to install this thing, but there's nothing to cut or solder. It's an **absolute must** for users of *AutoCAD*, desktop publishing packages, and word processors. And it's only \$39.95!

This was the show where some honest-to-god **MCA clones appeared**. The most bizarre was a be-all, end-all, do-all machine from Darius Computers in Seattle ((604) 432-7727). Dubbed the Darius ProPortable, it comes with a 25-MHz 386, a VGA-compatible plasma display, 16MB of RAM, a 100MB ESDI hard disk, two MCA slots, an Ethernet controller, an SCSI port, a serial port, a parallel port, a modem, a fax modem, a cellular phone interface, and a built-in inkjet printer. It was a portable! I poked around the thing wondering where the toaster oven was.

The brains behind this machine is Farad Azima, a high-end audio purist (Mission Electronics) who believes that **cheap, junky computers are ruining the country**. The genuinely hot product from this group is a rather rugged and impressive file server called the CentralIntelligence. This \$12,500 black beauty is something I'd seriously consider if I wanted reliability. It simply exudes a feeling of quality.

On the other end of the MCA spectrum, Mitac had a nifty **Model 55 clone**, with MCA bus and all. Apparently IBMers were crawling all over the Mitac booth—IBM hasn't even released its Model 55 yet. Mitac wins this year's award for **modex**, hands down.

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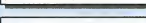
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CIRCLE 245 ON READER SERVICE CARD

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Jim Seymour



True or false?

**With a PC fax card,
you can't include your
signature in an
outgoing fax without
using a scanner.
False. Surprised?
Take a look
at Seymour's
commonsense,
scannerless solution.**

Last issue, I talked about the burgeoning fax culture and how personal computer fax boards fit into that scheme. This time, I want to pass along one of the slickest PC fax tips I know—and also the story of how I got snookered on this one.

As I've written in this column before, I don't see a PC fax card as a replacement for a "real" fax machine, but rather as a new, different, and very useful *extension* of fax capability. One reason I don't see fax cards replacing fax machines is the cost and clumsiness of buying, setting up, and using a scanner to read outgoing documents into the system whenever you want an exact image of your original to land on the desk of your fax correspondent.

Corporate PC users have told me time and again that they agree: for that kind of outgoing fax, they'd much rather use a regular fax machine. But they've often added that they sure wished there were some option in between the drab, plain-vanilla, dot-matrix-look output of fax-card-originated messages and the full-blown, letterhead-plus-signature output of standard fax machines.

Sure, you can get that "page image" look if you have a scanner hooked up to your PC. But hardly anyone buys—or should buy!—a scanner primarily for PC faxing. Most PC fax software offers a means of attaching a letterhead and signature graphic to outgoing messages. But you have to get those graphics onto your PC's hard disk in the first place . . . and sans scanner, that's impossible.

Well, not exactly.

MAGIC IMAGE INPUT

So many business users of PC fax cards had told me they wanted this capability that, a year and a half ago, I began passing along to fax-card vendors their requests for a scannerless method of getting graphic images into PCs for outgoing faxes. They nodded, muttered, and agreed that would be great but tough to do.

Then about a year ago, in a sneak-preview session with yet another fax-card vendor, I went through my little dog-and-pony show about people who don't have a scanner at hand but need to attach letterheads and signatures to faxes. "Aha!" cried the vendor's VP of mar-

keting. Anticipating that very need, the folks at this company had built a special feature into their fax-card system. Once you'd installed *their* fax card in your PC, you just transmitted to that card a blank sheet of your stationery, with a signature somewhere on the page. You could use any standard fax machine for the transmission—even one of those dollar-a-page deals down at the corner copy shop.

Then, at your PC, you called up that letterhead and used their bundled graphic-editing software (*PC Paintbrush*) to save the letterhead part and the signature part. Thereafter, you could add each part to outgoing PC faxes with just a couple of keystrokes.

You didn't need a scanner: you just used the scanning capability of the fax machine that sent your letterhead to you! It was brilliant, and brilliantly simple. What a killer feature! So, for the next several months, I added this clever solution to my talks with other fax-card vendors, suggesting that they develop something simi-



lar. Without exception, they marveled at the simplicity and cleverness of the idea and said they'd sure like to be able to do that, too.

HIDDEN TALENT

As it happened, a couple of months ago I had another of those preview sessions with people from yet another fax-card vendor. We looked at their soon-to-be-released product; we marveled at its smarts; we proved it worked by sending a

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Jim Seymour

fax to my fax machine down the hall. And they asked what I thought they should change or add. Of course, I went into my little spiel about how a competitive product, on the market for a year now, had this killer feature, which allowed you to . . .

When I finished, the marketing and engineering people nodded, muttered, and agreed that would be great, but tough to do. "But, but . . ." sputtered the company's PR woman, at the end of the table, "you can do that with your product! That's what I did to fax out your press releases. I just thought about it for a while and decided that it would work, and it did."

We all looked at her in silence for about 5 seconds. And then everyone in the room

**There was no magic
in the fax software.
Its developers had
just outthought me.**

exploded in laughter. Of course you could do that with their product! In fact, you could do it with virtually every fax card on the market! As long as the product bundled *PC Paintbrush* (or at least supported .PCX files, so that you could beg or borrow someone's copy of *PC Paintbrush*) and allowed you to attach graphics files at the top and bottom of outgoing files, you could do that with anyone's fax card.

There wasn't any magic built into that other fax card's software, nor even any special feature. Its developers had just outthought the competition—and me.

I'd fallen headfirst into their trap. And no one to whom I'd passed along the idea in the ensuing year had caught on, either.

Since then, the idea of faxing yourself letterheads and other forms for editing and subsequent use with your PC fax card has become one of my favorite PC fax tricks. I'll bet a lot of *PC Magazine* readers will find it handy, too.

I also learned a lesson about the importance of skepticism. Maybe you'll find that one handy, too.

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CIRCLE 174 ON READER SERVICE CARD

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CIRCLE 146 ON READER SERVICE CARD

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William F. Zachmann



PS/2 sales figures have led some observers to the conclusion that IBM's Micro Channel is 2 years ahead of EISA. But do these machines—with their 16-bit buses—really have a head start?

It has been just 6 months since I wrote ("IBM at War with the World," January 31, 1989) that the battle between IBM's Micro Channel architecture and the Extended Industry Standard Architecture sponsored by AST, Compaq, Epson, Hewlett-Packard, NEC, Olivetti, Tandy, Wyse, and Zenith was "likely to be the single most important hardware conflict of 1989."

A flurry of press accounts early this spring suggested that IBM might be gaining ground with its MCA. Articles in the trade press, subsequently picked up by the national business press, saw apparent gains for MCA.

As the year wears on, evidence mounts, and reasons increase to expect that EISA, not MCA, will prove victorious in the struggle to define the hardware foundation for the next era of industry-standard personal computing.

MCA's MUSCLE

A good starting point is to examine the appearance of strength for MCA and the reality behind it. First of all, it has been claimed that MCA is a lot further along than EISA. MCA was introduced with the IBM PS/2 line (and OS/2) in April of 1987. Close to 3 million MCA machines will be installed by the end of 1989, while EISA machines have yet to ship.

The problem, however, is that the vast majority of the MCA-bus PS/2s sold so far haven't got the real MCA bus in them and never will. That's because they are 16-bit systems, which will never take advantage of the updated 32-bit version of the MCA bus that is necessary to make real use of high-speed peripherals and bus mastering. Those IBM PS/2 Models 50, 50-Z, and 60 with a 16-bit MCA bus are no more capable of making practical use of high-speed bus mastering than are the even more numerous PS/2 Models 25, 30, and 30/286, which haven't got an MCA bus at all. The original 32-bit versions of the MCA in PS/2 Models 70 and 80 are likely, at best, to require costly upgrades before they can make use of anything the real Micro Channel architecture has to offer.

It should have been apparent to anybody who bothered to look at the original MCA spec that the five reserved pins on the 16-bit section and the additional 16 reserved pins on the 32-bit portion of the bus weren't there just to occupy

space. The original MCA, like the original IBM 370 Model 155 and 165 mainframes introduced in 1970, was never meant to be "the real thing."

IBM subsequently introduced the "real" 370 mainframes with dynamic address translation and demand-page virtual storage only after lots of customers had bought the original 370/155 and 165. Those lucky early customers were generously offered an expensive DAT (dynamic address translation) modification.

In the case of MCA, the 16-bit PS/2s don't even have the possibility of upgrading to the "real" MCA. Model 50, 50-Z, and 60 buyers have the privilege of knowing that, rather than buying the path to the future, they were simply buying a nonstandard 16-bit personal computer that couldn't even run as fast as old-fashioned AT-compatible systems with comparable speed processors and disks.

Under all the hype, the "real" MCA (with true 32-bit performance and usable bus-master-

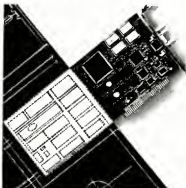


ILLUSTRATION: CATHY HILL

ing capabilities) is little more than an upward-compatible migration path for the 3 million or so MCA-based PS/2s sold thus far. EISA, on the other hand, provides a true 32-bit upward-compatible path for nearly 30 million AT and compatible systems already in place.

TIPPING THE SCALES

Aside from MCA's so-called 2-year "head start" over EISA, there is little objective basis

William F. Zachmann

on which to claim any real advantage for MCA. Functionally and technically, neither the inherently 32-bit EISA nor the true 32-bit MCA has any compelling advantage over the other. Both provide the substantial performance advantages of a 32-bit bus, bus-mastering capabilities, and

automatic recognition in hardware for cards inserted into a system.

To the extent that there are any technical advantages, they tend to work in favor of EISA. MCA boards are smaller than EISA boards, and less power is provided to the board. This carries a slight advantage because you can put MCA boards into a smaller chassis. It has a much greater disadvantage, however, because it will certainly mean that a larger and more diverse

range of EISA boards will be built than MCA boards.

The smaller size and lower power of the MCA require a board-maker to develop specialized chips and to use surface-mount technology for an MCA board. Of course, surface-mount chips and ASICs can and will be used with many EISA boards as well, but they aren't as essential as they are with MCA. Thus, EISA boards generally require a smaller investment to develop than MCA boards do.

EISA boards can be more easily constructed with standard components. Specialized boards that aren't likely to sell in large quantities can be designed far more easily for EISA than for MCA. The result will be a much wider selection of EISA



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CIRCLE 290 ON READER SERVICE CARD

**The growing number of
EISA announcements
means deep trouble
for IBM's MCA.**

boards than MCA boards.

Most important of all, not only is MCA's head start deceptive, but EISA is actually well ahead of MCA in critical areas. Standard chip sets to support true 32-bit bus mastering for EISA are already available from Intel. Comparable chips for true 32-bit MCA systems with bus mastering are still little more than vaporware outside of IBM.

Add to all this the disadvantages to other vendors of IBM's proprietary control over MCA, the advantages to users of the more intense competition that a standardized open architecture like EISA provides, and the growing number of announcements of EISA systems, cards, and software, and the sum equals deep trouble for IBM's MCA and growing success for EISA.

Mark my words: By this time next year, there won't be any doubt that EISA is well ahead of MCA in the battle to define the direction for industry-standard personal computing in the early 1990s. Nor will there be any doubt that EISA systems, boards, and software are leading the way to new levels of function and performance in PCs and network servers. ■



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CIRCLE 516 ON READER SERVICE CARD

Stephen Manes



**For those who've been
around the block once
before, buying a new
PC may feel like
second-car syndrome.
When you take your
new machine for a
joyride, it won't feel
quite like the first time.**

I finally went and did it: I bought a new machine. Ever since the announcement of the IBM AT, everybody has been telling me I desperately need one. Back then, all this great 286 software was "just around the corner . . ."

My old original 64K IBM PC—286ed, RAMed, ported, and hard-disked over the years—still runs fine, but it's out of slots and won't run 386 software nohow. Besides, it's served me well for nigh unto 7 years, the traditional point at which one releases one's indentured servants. So I treated myself to a 25-MHz name-brand clone—"name-brand" meaning the company releases its own version of OS/2—with 6MB of 32-bit memory, a 150MB 18-ms.-access hard disk, a 16-bit VGA card, and plenty of room for expansion. Hot stuff. Expensive stuff.

So why did I experience no palpitations when I opened the box? Why did my heart not sing as I contemplated the marvels of this speedster? Blame it in part on second-car syndrome. The difference between no car (or computer) and any car (or computer) at all is so vast that you can't help feeling the new acquisition has literally changed your life; it has. The difference between an old beater and a spiffy new model just can't be as dramatic. When you get right down to it, the new machine won't do much more than the old one—it'll just do it with a tad more style and acceleration.

Besides, you know—you just know—that 10 minutes from now a newer, faster, hotter model will arrive on the scene and knock your "pride of ownership" down a peg; I'm already hearing about 33-MHz bombs, EISA jets, and 486 rockets. And your romantic notions tend to disappear with your virginity; you quickly develop a sense of the effort required to maintain the delicate relationship between you and your machine.

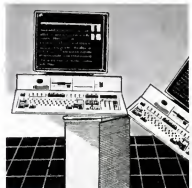
So ending that relationship and beginning another is—not to get too mawkish about it—akin to divorce. You're swapping the machine you've lived with—one whose foibles, quirks, and bugs you know and understand—for a parcel of unknown peccadilloes and vexations:

Somebody Set It Up for Me. The folks who installed the hard disk and floppy disk drives in the system kindly went out of their

way to format the disk with a single giant partition that I now realize makes about as much sense as the AUTOEXEC.BAT file consisting of superfluous DATE and TIME commands.

Bonfire of the Vanities It Ain't. I just haven't seen system-unit documentation in a while. Lucky me. With my machine came half a dozen nearly identical ugly desktop-published volumes, spiral-bound so you can't tell which one you're grabbing. By industry standards, these would probably be called "pretty good," meaning some of the information you need is in there somewhere. The table of contents of one of the DOS manuals, for example, leaves out all commands beginning with letters that come after D. That's the least of the problems.

Somebody Changed the Lock. It's not IBM, as its flaccid touch told me instantly, but the keyboard mimics what QWERTY savant Edward Mendelson calls the IBM Enyucked layout. I considered a third-party unit, but since the laptop I use sort of resembles the standard



and the next one I buy will probably come even closer, I'm surrendering, even though reflexes that were once automatic now require thought. So let's make things better: for instance, has anybody made rational use of the groupings of four into which the 12 top-row function keys are sensibly divided?

Call the Movers! Transferring megabytes of data from one machine to another isn't a no-brainer. *Lap-Link* and programs of its ilk make

Stephen Manes

the job relatively easy, but there are catches—like remembering not to copy old-version DOS files such as COMMAND.COM over the new ones. But you may arbitrarily decide not to move certain clearly useless files over to the new machine. This will not prove to be a mistake until you unhook the cables and lug the machines to opposite ends of the room.

Compatibility Boxed. Once you've moved your important files, you begin to make really interesting discoveries. Your keyboard enhancer won't work with your new keyboard, so you're stuck temporarily relearning program commands you've long since forgotten and listening to the clarion beep of the keyboard buffer overflow. Your ancient cursor-speedup program doesn't work, so your word processor seems sluggish.

Your file manager doesn't comprehend the new big-partition version of DOS. Your notepad sends your monitor into a tizzy when it pops up over a VGA screen. A dozen programs require laborious re-

tweaking to run on VGA instead of Hercules. The CD-ROM player shows you directories whose filenames include lots of line-drawing characters. You're not entirely sure what this oddball "3.3 Plus" version of DOS is by IBM standards, or whether it will support any of the handy disk utilities you use about once a year. Your year-old edition of *The Norton Utilities* thinks your hard disk is a floppy. At least *WordStar 3.3* runs fine.

You Want a Tower, Get a Tower. The new machine comes AT-box-style only, but I need to put it on the floor. So to change a card, it's: remove box from stand, remove six screws, orient machine so the cover will come off, do what needs to be done inside, go through the process in reverse. I begin to fathom the wisdom of the IBM Model 80.

Glasnost in Reverse. Good old CHKDSK used to tell you straightforwardly how many bytes it found in bad sectors. No more. My new version weaselly and euphemistically informs me that a million or so of the bytes on my hard disk are "unavailable."

Want to See It Again? Some subtle forms of feedback no longer apply. The

AUTOEXEC.BAT file whips by so fast that I had to insert pause commands just to find out what was executing and what wasn't. Spreadsheet changes used to ripple down the screen; now I press the Enter key and it's done. My ancient database program can find anything in my files instantly. At times I almost want to say, "Relax! Give me a break!"

Result: The slightest delay—as with electronic mail and on-line services—becomes more intolerable than ever. My hitherto adequate 8088 laptop now seems positively glacial.

That's Performance! One of the most annoying things in computerdom was that excruciating 6-second delay for the opening *Lotus 1-2-3* screen on my old machine. Now, with my 386 machine, that delay is a mere 1/10 minute.

I had no idea high-density 3½-inch floppies go for \$4 a pop, just 300 percent more than their AT-style 5¼-inch counterparts. Now there's a price/performance ratio defense contractors can appreciate!

Well, getting near the end here. Better save this column. Gee, that was fast. Hmmm. I hear there's some great 386 software out there . . .

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CIRCLE 237 ON READER SERVICE CARD

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BUYING HARD DISKS BY MAIL

by Henry Fersko-Weiss

The message on your screen is clear: "1701 ERROR NO BOOT DEVICE AVAILABLE." You've finally reached the mean time between failures: your hard disk has died. Luckily, you backed your system up just the other night, so maybe this is a blessing, you think. For the past 6 months you've been short on disk space. It's finally time to get a bigger hard disk.

The scene this story paints is very real. If you've had a 20- or 30MB hard disk for several years, you need to think about its eventual demise. You're certainly feeling the pinch of its limited space, too.

Today, a 40MB disk is the standard size for an AT-class



ILLUSTRATION: LARRY CORRETT-THIEL

There's no reason
to fear shopping for a new
hard disk through
mall order.

**A PC Magazine investigation
reveals that a little
research, combined with
some common
sense, can lead you
to a wealth of
hassle-free bargains.**

PC. If you're running an 80386 system, it's the minimum size, and you'll need an even bigger disk if you're contemplating using OS/2 or Unix. Some disk-crowding applications like desktop publishing may require more than 40MB as well.

Of course, there's no need to stop at 40MB. Our PC MagNet survey of over 400 readers shows that while 40MB is the most prevalent disk size being bought through mail order, many people are making the leap to 60-, 80-, and even 100MB. Though prices of huge disks can be intimidating, some careful shopping can uncover interesting bargains like a Seagate 80MB model we spotted for \$549.

Price isn't an obstacle to owning a 40MB hard disk. If you shop carefully, you can buy one for somewhere between \$319 and \$399 (without controller). Two years ago, that amount would have paid for a 20MB disk from one of the higher-price mail-order companies. By buying through a mail-order company, you are almost sure to find an excellent deal.

SHOPPING SAFELY

Some people still can't bring themselves to buy mail order despite the obvious savings. For them, buying through the mail has a scary feel to it. The companies seem so remote, so disembodied. But mail order can be perfectly safe if you use a little common sense.

One of the most important and obvious rules is to buy from a reputable company like the eight we've looked at here. These establishments represent a cross section of the industry—from those in business for as much as 6 or 7 years, like PC Connection and CompuAdd, to those just starting out, like Zeos International. Some companies carry 200 products, some carry 2,000. Hard Drive International sells only hard disks, while Zeos International sells mostly computers. Fast Micro takes orders without giving advice, while other companies have salespeople with degrees in computer science who can tell you everything you need to know about hard disks.

At the same time that we evaluated the performance of the companies, we tested the performance of their biggest-selling 40MB hard disks. The most popular brand name—by a factor of three—is Seagate. No matter which mail-order company you call, if you ask about 40MB hard disks the salesperson will undoubtedly mention Seagate first. Seagate has a few 40MB disks, of which the ST251—with an access speed of 40 ms.—and the ST251-

1—with a speed of 28 ms.—are the most in demand. We tested the ST251-1.

Second to Seagate is MiniScribe. It offers three 40MB disks: the 3650, 8450, and 3053. They have access speeds of 61 ms., 46 ms., and 28 ms. respectively. We tested the 3053. Some mail-order companies sent us both the Seagate and MiniScribe disks.

We also looked at a couple of less well-known high-performing 40MB disks: the Priam ID45 (23 ms.) and the Mitsubishi MR535 (28 ms.). All the hard disks we looked at were half-height in size and had 1-year warranties.

To compare the performance of the four disks, take a look at our benchmark tests.

**Naturally, the
first thing to
consider when
buying a hard disk
is compatibility
with your present
controller.**

You'll see that it's difficult to single out one disk as the best and another as the worst. Any one of these disks is worth buying. All four disks are dependable, and while there may be slight differences in media reliability, all of them will probably still be running strong when you decide to upgrade again in 3 to 5 years.

WHICH DISK?

Naturally, the first thing to consider when buying a hard disk is compatibility. If you already have a hard disk, it's important to find out what kind of disk controller your computer has. If you have an AT-class machine, it's likely to have a Western Digital WD-1003-WA2 controller. This controller and others like it can support a wide variety of disks, including 40MB models; so all you have to do is plug in the new disk. The mail-order company should be able to tell you whether your controller will work with the hard disk you want to buy. Even if

your computer is an obscure brand, your controller is probably standard. If you're wondering, a good mail-order sales rep should be able to answer your questions.

Some popular AT compatibles require a little tweaking to use a common 40MB disk, and Compaq machines are the most difficult. Different Compaq models have different requirements. Some early Compaq AT-class machines used the Western Digital controller (into which you can plug any standard 40MB disk), but later models use semiproprietary controllers and somewhat modified disks from MiniScribe and Conner Peripherals. This forces you to buy replacement disks from an authorized Compaq dealer, go to a mail-order company that sells Conner Peripherals models (the disks are more expensive; a 40MB disk can cost \$565), or replace the controller (about a \$150 option).

Tandy presents a different sort of problem. Its 286-based 3000 was commonly sold without a hard disk, and the controller for the floppy disk drives is on the motherboard. When you buy a hard disk for it, you have to get a controller that directs only the hard disk. One such controller is Western Digital's WD-1006-MM1.

ASSORTED INTERFACES

Another thing to consider when matching hard disks to controllers is the interface. There are three common PC hard disk interfaces: ST-506/412, ESDI (Enhanced Small Device Interface), and SCSI (Small Computer System Interface). ST-506 was the first PC interface standard, set in the early 1980s. Next came the ST-412, which was later merged with the ST-506. This interface has two data-encoding methods associated with it, MFM (Modified Frequency Modulation) and RLL (Run Length Limited). The encoding systems relate to the patterns of electrical pulses and silences that are translated into binary 1s and 0s. The ST-506/MFM standard is far and away the most common.

The MFM approach is the oldest. It requires 17 sectors per track and has a 5-megabit-per-second transfer rate. The RLL encoding method squeezes more data onto the hard disk by allowing 26 sectors per track, which yields a 7.5-Mbps rate. While RLL disks store more data (65MB can be squeezed onto a 40MB disk) and operate faster, they are generally more expensive because the disk medium has to withstand increased demands. If you decide on an RLL disk, make sure you get an RLL controller as well.



HARD DISK DECISIONS

by Henry Fersko-Weiss

You'll have to consider more than milliseconds and megabytes as you look for the perfect hard disk.



STARTING OUT

Hard disks are 3 1/2 or 5 1/4 inches wide, and either half-height or full-height. Most are 5 1/4-inch half-height, but you can request an appropriate faceplate if you have to cover a full-height opening. The 3 1/2-inch disks can go into 5 1/4-inch spaces with special mounting rails (usually supplied with the disks). The controller you'll buy (about \$150) will handle two 10MB to 160MB hard disks and two floppy disk drives. The four connections you have to make to install the disk (ground, power, data, and controller) are easy, since most of the cables are color-coded or slotted. Consider keeping your old disk installed as a backup device, but if you do, you'll have to change the jumper setting on your new disk to indicate that it is the second drive. A typical 40MB hard disk should cost between \$389 and \$489.

SPEED DECISIONS

A floppy disk has an average access time of 300 milliseconds (3/10 second). The first XT hard disks had an access time of 80 to 110 ms. Today, you should consider no hard disk slower than 28 ms., unless you're determined to snap up a bargain. Although a 40-ms. disk will seem fast if you're currently using an 80-ms. disk, the additional cost for 28-ms. speed (\$50 to \$100) is well worthwhile.



BIGGER, FASTER OPTIONS

OS/2, large applications, and enormous data files may inspire you to look for a hard disk far larger than 40MB. As hard disks get bigger, they would normally get slower, but ESDI and SCSI interface technology—found mostly on disks over 70MB—keeps them fast. ESDI is an evolutionary step up from the ST-506/412 standard, increasing throughput by up to 40 percent.



The drawback is cost. A 150MB ESDI drive with controller costs from \$1,300 to \$1,600 through mail order. SCSI controllers and drives make sense if you plan to install several disks or peripherals together, because one controller can handle up to eight devices, including CD-ROM drives and scanners. As with ESDI, the price is high, but it's coming down. A 65MB Seagate SCSI drive can cost about \$650 with a controller. A 160MB SCSI drive with an embedded controller runs about \$1,200. Both ESDI and SCSI are best mated to a 386 system.

STANDARD INTERFACES

The overwhelming majority of PC hard disks in existence today operate under the ST-506/412 interface standard. The popular Western Digital WD-1003-WA2 disk controller uses it. Two encoding methods come under the standard: MFM (Modified Frequency Modulation) and RLL (Run Length Limited). MFM is by far the more prevalent, although RLL controllers—which cost about the same—speed data transfer and increase disk storage by up to 50 percent. These factors combine to create some impressive bargains. Though technically any hard disk can run with an RLL controller, you should make sure your drive has been certified as RLL: RLL disk drives have to withstand extra strain. If you try to run an MFM drive with an RLL controller, you'll void your warranty.



CONTROLLER ISSUES

If you already have a hard disk, or if you have a floppy-disk-only AT compatible, then you already have a hard disk controller, and chances are that it comes from Western Digital. For most upgrades, there's no reason to buy a new controller. Also be aware that interleaving, which determines how data is placed in sectors, can affect the access speed of the disk. Find out how flexible your controller is in setting interleaving, and be sure to optimize to the manufacturer's specifications.



SPECIAL CASES

The easiest way to get mass storage fast is to install a hard disk card (Plus Development Corp. makes the best models). Hard cards, however, haven't gotten larger than 50MB, and at equivalent prices they tend to be slower than regular hard disks. Potential controller conflicts are also a problem.

Compaq machines have proprietary drives and controllers. To upgrade, you have two choices: keep the controller and buy a new Compaq-style disk (which can cost \$400 to \$450 more than a regular disk if bought through a Compaq dealer), or add a new controller in an expansion slot and get a standard MFM or RLL drive.

In the PS/2 arena, the Models 25 and 30 have their floppy disk controllers on the motherboard, as the Tandy 3000 does, so if you want to change drives you'll have to buy a hard-disk-only controller. Then you can install an MFM or RLL drive. If your Model 50 or 80 has an ESDI controller, you can upgrade with any ESDI disk. If not, you're stuck with IBM disk and controller upgrades, because there are no independently manufactured Micro Channel drive controllers (though Adaptec is promising some for the future).



MASS STORAGE
MAIL-ORDER HARD DISKS

The speed advantages of RLL allow you to save money. For example, if you trade in your controller to Hard Drive International for \$50, buy an RLL controller for about \$150, and save \$70 buying a slower hard disk, your net cost for the RLL upgrade is \$30, and you end up with a disk that can hold far more data.

The ESDI interface, which is popular in network servers and 386 machines, was developed by Maxtor in 1983. It uses cables of the same size and shape as ST-506/412 but has 34 sectors per track and a 10-Mbps transfer rate. The ESDI interface is an evolutionary step up from ST-506/412. It achieves 25 to 40 percent faster throughput by moving certain signal operations from the controller to the hard disk itself. The disks must be specifically designed for ESDI.

SCSI is a relative newcomer. Although the original SCSI interface development started in the 1970s, it wasn't until the Macintosh came out with a SCSI port a few years ago that it started to attract a lot of attention. The beauty of the SCSI interface is that it lets you control up to seven devices with one controller. You could have your hard disk, an optical disk, and a scanner all linked to one board. SCSI disks can have 26 or 36 sectors per track, and the transfer rate is 32 megabits per second—with the promise of a future rate ten times as fast. Seagate makes one 40MB SCSI disk, the ST251N. Some industry experts expect SCSI to become the main hard disk standard in 5 to 8 years (Tandy is one of the companies taking the lead in the SCSI arena).

THE SPEED FACTOR

Hard disk performance is not dependent on the interface alone. The abilities of the controller are just as important. This brings us to interleaving, which describes how data is placed in sectors. An interleave of 1:1 means that data is placed in sequential sectors. This is difficult to accomplish because many controllers aren't capable of getting the data to the read/write head fast enough to keep up with the speed at which the disk is revolving. If the disk is set for a 1:1 interleave and the controller can't manage it, then the disk has to spin around again to come back to that next track. This can slow up a hard disk's throughput by as much as 80 percent. A 1:3 interleave means that data is recorded in every third sector. You can have an interleave scheme of up to 1:16. You set it during the low-level-format routine.



PINNING DOWN PRICES

The only way to find the best mail-order hard disk deal is to shop around.

If you are considering the purchase of a mail-order hard disk, it makes sense to shop around. This chart lists sample 40MB hard disks, showing that mail-order prices gravitate toward similar levels but are never standardized. You can generally find a given hard disk listed at several different prices—sometimes from the same company on the same day.

Mail-Order Company	Disk	Price
Arlington Computer Products	Seagate ST251-1	\$399
Fast Micro	Mitsubishi MR535	\$399
Zeos International	MiniScribe 3053	\$399
Zeos International	Seagate ST251-1	\$399
Hard Drive International	MiniScribe 3053	\$409
CompuAdd	Seagate ST251-1	\$439
Fast Micro	Seagate ST251-1	\$449
PC Connection	Seagate ST251-1	\$449
Shamrock	Seagate ST251-1	\$449
CompuAdd	MiniScribe 3053	\$459
Computer Discount Warehouse	Priam ID45-AT-D2	\$468
Shamrock	Micropolis 1333A	\$649

It's important to know what the optimum interleave is for your hard disk controller to get the maximum performance out of your hard disk. If this information isn't in your controller manual, ask the tech support people at the mail-order company or contact the disk manufacturer.

Speed is another important consideration when choosing a hard disk. The most common 40MB speeds are 40 ms. and 28 ms. Deciding between the two is a matter of weighing price against performance. If you have had a 20MB disk for a few years, it probably runs at somewhere between 60 ms. and 80 ms., so 40 ms. will seem much faster to you, but the 28 ms. speed tends to be more appropriate for the kinds of tasks AT-class users perform. The price difference isn't big; buy a 28-ms. disk.

Once you've narrowed down your hard disk choice, it's time to pick the mail-order company. Many people think that price is the only consideration at this point. Not true, especially if you don't know a lot about hard disks. Service and support can be crucial (and your time is valuable, too).

Some mail-order companies have highly trained service and support personnel; others do not. Differences also show up in the kinds of guarantees the companies offer, ordering and shipping policies, the number of hours they are open, the kinds

of software they include with the disk, the documentation, and so on.

GOOD REPUTATIONS

Checking into the reputation of a mail-order company is a good idea, but it can be difficult to do. The first course of action is to ask friends and colleagues about their experiences. You can also call the Better Business Bureau in the city or state that is home to the mail-order company. The Better Business Bureau will tell you how many unanswered complaints there are against the company. This information should be reviewed with some caution. It's hard to be in business and not have one or two complaints lodged. If the number is small, ask the mail-order company about it. Some people complain over perceived problems or unrealistic expectations, but if a company has a great many unanswered complaints, then stay away—no matter how good the price is.

You should be prepared to ask as many questions as you need to make sure that the salespeople and technicians sound knowledgeable. Ask a lot of "what-if" questions on their ordering, service, and support policies. Perhaps one of the best checks on a company is how you feel when you're talking to its sales or technical personnel. If they make you feel rushed, don't



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Protection Made Easy.

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seem interested in your particular situation and applications, or act condescending or unfriendly, move on.

The safest way to buy through mail-order houses is by VISA or MasterCard, because you know you can withhold payment to your bank if something goes wrong. American Express doesn't always offer this safeguard. Personal checks, certified checks, money orders, and such are more difficult to recover, though you should check to see if you can get a discount for using a certified check.

After you've received your hard disk, you have to go through a fairly simple installation process. The physical connections are quite simple: just make sure you match the ends of the cables to the proper side of the edge connectors on the disk drive. If you're installing the disk in tandem with your old drive, you'll probably have to change a jumper setting to invoke the number two drive select position.

Next, you may have to do a low-level format. Some mail-order companies do this for you and will also partition the disk at no extra cost. Mail-order companies report that most hard disks returned as defective were actually simply set up incorrectly by the buyer.

Mark off all the bad sectors on the disk so that data won't fall into these potholes and set the interleave scheme. All hard disks come with sectors damaged in manufacture—it's unavoidable. The bad-sector map is usually taped onto the top of the drive. The low-level format can be accomplished with the AT diagnostics utility or an off-the-shelf product such as Ontrack Computer System's *Disk Manager*. In fact, *Disk Manager* was sent with every disk we received except for Priam's, which came with its own utility. Some of the very newest 16-bit hard disk controllers have an on-board BIOS that eliminates the need for software to perform the low-level format or partitioning. One such popular controller is the Adaptec 2372. Western Digital doesn't offer this type of controller yet.

Partitioning a disk entails splitting it into chunks of usable space. You have to do this even if you want the whole 40MB to be configured for one drive designation, such as C:. By splitting the 40MB into two or more pieces, you increase the response speed of the disk because the read/write head will move across a more limited span of the disk. Partitioning is done with the FDISK command or a disk-management utility.

Among all the mail-order companies out there, there's bound to be one that meets your combined set of requirements in price, service, and support. The work is up to you. Research your purchase, get several comparative prices, and stay alert. Take those simple steps, and your hard disk upgrade will be quick, painless, and inexpensive.

In the reviews that follow, we set out to judge the quality of assistance that mail-order salespeople give during the ordering process, the quality of telephone tech support during installation of the disks (we called anonymously and acted unknowledgeable), the quality of documentation that comes with hard disks (both from the disk manufacturer and the mail-order company), and the selection of disks and prices that the company offers.

Arlington Computer Products

If you're a little unsure about ordering equipment from a mail-order firm, Arlington Computer Products does its best to set your mind at rest. Its sales and technical support staffs are courteous and patient, and they possess more than just a paper knowledge of their products. Each order agent has a computer linked to the company's mainframe database of product and inventory information, and he or she will take the time to advise you on the best purchases for your situation.

The sales representatives attend weekly training sessions with vendors. The technical support staff also attends training sessions, and they gain first-hand troubleshooting experience by testing products sent back for repair. If you stump them with a problem, they will contact the product's vendor directly for you.

Although Arlington's ordering hours are relatively short compared with those of other companies, the company's toll-free line is rarely busy, and most orders are shipped UPS ground within 24 hours. Arlington accepts all methods of payments but charges 5 percent extra on American Express purchases.

All of Arlington's hard disks, which are available in 20-, 30-, 40-, and 80MB configurations, are manufactured by Seagate.

Its close ties to this one manufacturer give it an edge when it comes to cost: the 40MB ST251-1 sells for only \$399 (without controller), considerably less than the price tags other mail-order houses put on the same unit. In addition, Arlington sells other low-priced peripherals, and computers from several manufacturers including IBM, Compaq, and AST.

The ST251-1 we got came from CMS Enhancements (one of Arlington's four distributors) in Tustin, California. A package of side rails and screws, a data cable, faceplate, and all the expected accessories were included with the disk. If you're buying the drive for a Compaq, just inform the representative and you will receive the necessary special installation kit with metal side rails and a power cable.

INSTALLING THE DISK

The ST251-1 came with a generic manual from CMS that tells you how to install any hard disk in a PC-, XT-, or AT-class machine. Because its instructions cover a broad range of machines, it doesn't tell you how to change jumper settings or what controllers a particular hard disk will work with. However, if you are knowledgeable about hard disks, the manual is well illustrated and gives a good basic explanation of how to install a hard disk.

The Universal Installation Handbook, a tiny pamphlet from Seagate, was also included. This clearly illustrated handbook covers most of the installation particulars for Seagate disks. Combined with the CMS manual, you'll have just about everything you need to know at your fingertips. The only thing that's missing from these manuals is information on disk-type designation, which you need for low-level formats and hard disk partitioning. Luckily, the Seagate version of Ontrack's *Disk Manager* software comes with a table of disk types listed by model number.

Installing the hard disk is a fairly simple task, but if you encounter problems, Ar-

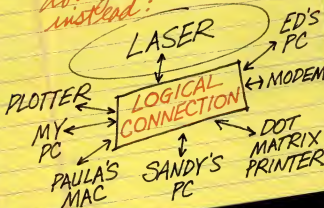


FACT FILE

Arlington Computer Products
3025-E St. Malmo, Arlington Heights, IL 60005
(800) 548-5105, (312) 229-6333
List Price: Seagate ST251-1, \$399.
In Short: Arlington offers worry-free mail-order purchasing at reasonable prices, especially if you are interested in the Seagate product line, its specialty.

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MASS STORAGE
MAIL-ORDER HARD DISKS

lington's technical support staff is readily available. Unfortunately, they do not have weekend hours.

Arlington doesn't offer a money-back guarantee, and returning a product will cost you a hefty 15 percent unless there are extenuating circumstances (determined at the company's discretion). However, if something is wrong with the disk, you can send it back for a replacement under the 1-year warranty. You pay the cost of shipping the machine to the company, and whatever method you choose, Arlington will match on the return. If the problem crops up early in the disk's life, the company is likely to replace the disk with a new one. A disk that is several months old will be repaired or exchanged for a refurbished disk of similar age.

Arlington has been in business for 5 years. It doesn't have a retail operation, but customers can pick up their orders at the Arlington Heights, Illinois headquarters. Though the ordering hours aren't the most convenient and there certainly are more flexible return policies available, Arlington employs cooperative, knowledgeable representatives and offers unbeatable prices.

CompuAdd

CompuAdd scores perfectly all the way across the board. When you buy a hard disk through this mail-order house, you also receive great service, competitive prices, comprehensive documentation, and free software. Even better, you get a 30-day "safety net" period during which you can return the hard disk for your money back—no questions asked.

CompuAdd runs 112 telephone lines into a pool of 56 sales representatives. If they're all busy, you reach a recorded message and are put into a holding queue that can handle hundreds of calls. Each sales person has two telephone lines; when you do get through, don't be surprised if your barrage of questions is interrupted by another call. One time I was put on hold for 6 minutes; by the time the sales representative returned, we both had forgotten what we were discussing.

The sales representatives are conversant with all the technical and performance issues pertinent to selecting a hard disk. Even when asked the most basic questions, they displayed patience and offered

accurate information—free of condescension.

CompuAdd has long ordering hours, and it accepts all payment methods. Normally, you will receive your product within 4 or 5 days. If an item is not in stock, however, it can take up to 2 weeks for delivery.

CompuAdd sells about 45,000 hard disks a year, and its prices are very competitive. The \$439 price of the Seagate ST251-I was one of the lowest we found; a MiniScribe 3053 cost \$459.

WINNING DOCUMENTATION

The documentation that came with each disk was the best of all products reviewed. Both the Seagate and the MiniScribe disks come with installation manuals targeted at the IBM AT and compatibles. The concise, well-illustrated manuals contain troubleshooting guides. In addition to all the basics, you get information about advanced techniques like creating multiple partitions for running more than one operating system.

Each unit also came with a couple of extra software goodies: Ontrack's *Disk Manager* and Westlake Data Corp.'s *PC-FullBak* backup program. CompuAdd was the only mail-order company to include an installation guide in addition to the instructions on the cardboard mailer that holds the program disk.

Although the manuals and *Disk Manager* make installing the hard disk very simple, CompuAdd has a well-trained technical support staff to field your questions. Their training involves spending several weeks in CompuAdd's repair facility and a number of sessions working with vendors. Twenty-five technicians man the support lines; seven are hard disk specialists and ten are dedicated to customer service calls. If that isn't enough for you,



CompuAdd
12303 Technology Blvd., Austin, TX 78727; (800)
627-1967, (512) 250-2548.
List Price: MiniScribe 3053, \$459; Seagate
ST251-I, \$439.
In Short: One of the giants of mail order,
CompuAdd offers quality hard disks, competitive
prices, excellent documentation, and courteous
service backed by a 30-day trial period and
money-back guarantee.

CIRCLE 428 ON READER SERVICE CARD

there are four engineers on board to handle your most complex questions. Together, they handle an average of 80 calls a day.

If you experience hard disk problems that can't be resolved over the phone, you can return your unit to CompuAdd to be checked for media, mechanical, and electrical malfunctions. If the disk passes these tests, the repair center recreates your problem. If after all this the disk does prove to be defective, you will most likely receive a new replacement, though sometimes refurbished hard disks are used. CompuAdd will match your shipping method on the return—generally within a 3-day time frame.

CompuAdd has been in the mail-order field since 1982 (and expects to do \$450 million in business this year); 4 years ago, it got into the national retail business and now boasts 15 stores, 8 of which are in Texas. If you prefer, you can go to one of these stores for service, but their diagnostic capabilities are limited, especially when compared with the company's technical support headquarters in Austin. When it comes to purchasing a hard disk, though, CompuAdd's good prices and quality documentation make both its retail and mail-order operations difficult options to ignore.

Computer Discount Warehouse

Computer Discount Warehouse's goal is to humanize the ruthless mail-order industry. Both the toll-free order and technical support lines are answered by real-live operators who cheerfully connect you to the appropriate party.

It certainly was a pleasant novelty to be greeted by a live operator and to work with sales representatives completely familiar with the company's internal procedures. The reps come by this knowledge through a training schedule that involves working a stint in every department, from shipping and accounts receivable to purchasing and technical support. Before they are assigned to the phones, the reps also spend some time as retail salespeople in the company's showroom. (Although Computer Discount has been in the mail-order business for about 6 years, it has recently opened up a retail outlet at its Northbrook, Illinois mail-order headquarters.)

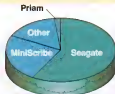


THE MAIL-ORDER EXPERIENCE

PC Magazine readers have found ordering hard disks by phone easy and safe.

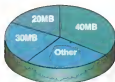
1. What brand of hard disk did you order?

Seagate	59.0%
MiniScribe	22.8%
Other	15.8%
Priam	2.4%



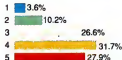
2. What size hard disk did you order?

40MB	35.3%
Other	24.8%
30MB	21.5%
20MB	18.4%



These five questions are based on a 1-to-5 rating system, with 1 for poor and 5 for excellent.

3. How would you rate the courtesy and knowledge of the salesperson to whom you spoke?



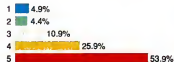
If you've never ordered computer products by mail, you're probably wondering whether doing so is risky or ill-advised. The answer, according to those who have done it, is no.

We posted a PC MagNet survey that asked people who had bought hard disks by mail to talk about their experiences. We logged 451 responses, the vast majority of which were positive: almost 88 percent of those surveyed said they would order from the same firm again.

The number-one mail-order hard disk brand is Seagate, with MiniScribe coming in second. To our question about disk capacity, 35.3 percent of the respondents replied that they had bought 40MB models. Of the 24.8 percent who answered "Other," the majority specified 80MB as the capacity they had chosen.

All those whose responses were tallied had bought a hard disk by mail within the past 18 months.

4. How would you rate the company's promptness in filling the order?



5. How would you rate the completeness of the kit?



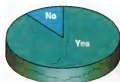
6. How easy or difficult was it to install the hard disk?

Very difficult	2.7%
Difficult	3.5%
Moderate	27.1%
Easy	40.8%
Very easy	25.9%

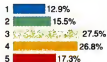


9. Would you order from the same firm again?

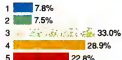
Yes	87.8%
No	12.2%



6. How would you rate the quality of the documentation?



7. How would you rate the quality of the company's technical support?



The MAXI RD45:
Blazing Speed.
Low Cost/Megabyte.
Convenient 45MB
Portable Cartridges.
SCSI Flexibility.
For PC, PS/2, Mac.

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CIRCLE 173 ON READER SERVICE CARD



FACT FILE

Computer Discount Warehouse
2840 Maria Ave., Northbrook, IL 60062; (800) 233-4426, (312) 498-1426.
List Price: Priam ID45 AT-D2, \$468.
In Short: Computer Discount offers a variety of disks at a variety of prices, and that can cause confusion. The sales staff, cooperative though it may be, tends to be misinformed on anything other than the basics. A good place for trying to best advertised prices you've found elsewhere.

CIRCLE 427 ON READER SERVICE CARD

Despite this diverse background, the hard disk information I received from the salespeople was often incomplete or incorrect. Not once out of a half-dozen calls did a sales representative question the age of my current hard disk or the controller card I was using. I was also informed by one salesman that I couldn't replace the 20MB hard disk in my IBM XT compatible with a 30MB model unless I also changed the controller. The reason he gave was that 30MB disks use an RLL interface, not an MFM interface. This simply isn't true.

In addition, every time I inquired about 40MB disks, I was quoted the prices of Seagate models only. When I asked about the prices of other brands, I was given a quote for a MiniScribe. Finally, I had to directly ask about the Priam disk the company had already sent me—and was told Computer Discount Warehouse didn't carry that brand.

WHICH PRICE IS RIGHT?

Computer Discount uses a discretionary pricing system in which the sales reps make judgement calls on prices. I was given three different quotes on a Seagate ST251-I on the same day: \$429, \$399, and \$392. The following week I got two other price quotes: \$409 and \$389. Since prices are negotiable, the salesperson may try to match a lower advertised price if it is brought to his attention.

Prices at Computer Discount change very frequently. Advertised products are stable for about a week, but only about 200 of the 700 actively stocked products at Computer Discount Warehouse are advertised at any one time. Altogether the company carries about 2,500 items. The pricing system may sound a bit confusing, even chaotic, but since the company is so willing to bargain, you may find a better

deal here than anywhere else.

At the time I received the Priam ID45, it was listed at \$468 and was low-level-formatted, with the error map entered. After the disk was installed we checked the number of bad sectors: although the disk was the largest reviewed (45MB), it had the fewest bad sectors. The disk came with a data cable and the side rails mounted but did not include a faceplate, LED light, or extra mounting screws.

Priam ships its own installation software and documentation. The installation manual is well written and, unlike the other manuals, includes an index. An excellent Priam user manual with a troubleshooting guide and installation instructions for Novell's NetWare was also included. The installation process is automatic; all that's required of you is to indicate how the disk should be partitioned and the position (first or second) in which it is being installed.

The technical support people at Computer Discount are able to handle most of the common problems you might have with the disk. But if a problem is too difficult, they will contact the manufacturer directly for you. If you return a defective disk within the first 30 days, you can opt for your money back or request a new one. If problems crop up after the first 30 days, the disks are either repaired or replaced with new ones at the company's discretion. Priam disks are protected by Computer Discount's 1-year warranty.

Computer Discount's sales representatives seem to be more interested in the final sale than in helping you find the right product. However, you can get an excellent buy if you call for price quotes at different times or push the salesperson for the best he or she can do.

Fast Micro

Fast Micro's approach to mail order is strictly no-frills. If you're looking for purchasing advice or explanations of a product, you won't find it here. About all you can get is a price quote.

Because it doesn't take the sales reps very long to quote the price and megabyte capacity of a hard disk, it's very easy to get through to them on the toll-free telephone order line. I found that talking to a Fast Micro

representative is very much like talking to a discount stock broker.

The company accepts any method of payment except C.O.D., and if you use American Express, there's a 5 percent surcharge. Fast Micro usually ships UPS ground, which will cost you 3 percent of an item's purchase price. Next-day service from Federal Express is a \$10 option.

Fast Micro sells the Seagate ST251-I for \$449—the highest price in the group reviewed here, but equal to what PC Connection and Shamrock charge. The Mitsubishi MR535 disk is competitively priced at \$399, but it arrived without documentation. If you're using an MFM interface, the Mitsubishi disk is formatted to 42½MB. With an RLL interface, the disk can store 65MB, making it an excellent buy for the money.

The Mitsubishi disk arrived with side rails and screws, but no cables. It is the only disk we received that came without *Disk Manager* or a proprietary disk-man-



FACT FILE

Fast Micro
3721 E. Grove St., Phoenix, AZ 85040; (800) 441-3278, (602) 437-3788.
List Price: Mitsubishi MR535, \$399; Seagate ST251-I, \$449.
In Short: If you're in the dark about hard disks, don't look to Fast Micro to shed light on the subject. Advice isn't this firm's specialty, but competitive pricing is.

CIRCLE 428 ON READER SERVICE CARD

agement program. However, the sleekly designed Mitsubishi did quite well in our benchmark tests, coming in right behind the MiniScribe in the Access Time tests.

SERVICE WITH A SMILE

If you don't know anything about installing a disk, the absence of documentation for the Mitsubishi is something to consider. The only alternative is to go the technical support route, and luckily, the staff at Fast Micro is competent. There are only three technicians, but they are congenial, tolerant, and knowledgeable. Each must complete a certified training course given by the manufacturers of the products sold by Fast Micro. Alas, the tech support service line is not toll-free.

Hard disks come with a 1-year Fast Micro warranty. Most of the time, a defective disk will either be replaced with a new one or repaired and returned. Fast Micro doesn't offer a money-back guarantee, so

MASS STORAGE
MAIL-ORDER HARD DISKS



MAIL-ORDER COMPANIES THAT SELL HARD DISKS: SUMMARY OF FEATURES

	Arlington Computer Products	CompuAdd	Computer Discount Warehouse	Fast Micro	Hard Drive International	PC Connection	Shamrock	Zeos International
Sample mail-order disk	Seagate ST251-1	Seagate ST251-1	Priam ID45-AT-D2	Mitsubishi MRS35	Miniscube 3053	Seagate ST251-1	Seagate ST251-1	Seagate ST251-1
Price	\$399	\$439	\$468	\$399	\$409	\$449	\$449	\$399
PRICE INCLUDES								
Mounting rail	●	●	●	●	●	●	●	●
Faceplates	●	●	○	●	●	●	●	●
Mounting screws	●	●	●	●	●	●	●	●
Cables	●	●	●	○	○	●	●	●
DOS	○	○	○	● (DOS 4.0)	○	○	○	○
OS/2	○	○	●	○	○	○	○	○
Utility to allow large partition	Disk Manager	Disk Manager	Priam software	None	Disk Manager	Disk Manager	Disk Manager	Disk Manager
Caching software	None	None	None	None	None	None	PC-Kwik	None
Utilities	None	PC-FullBak	None	None	None	None	TakeTwo Manager	None
DOCUMENTATION								
From mail-order house	○	○	○	●	●	●	●	○
From disk manufacturer	●	●	●	○	○	●	○	●
Illustrated installation instructions from mail-order house	○	○	○	○	○	○	●	○
Factory test sheet	●	●	○	○	●	●	○	●
MISCELLANEOUS								
Disk can be ordered preformatted	●	○	○	●	●	○	●	●
Surcharge for credit-card order	5% (AE only)	None	3% (AE, V, MC)	5% (AE only)	5% (AE, V, MC)	None	3% (AE only)	None
Method of payment	AE, V, MC, PC, BC, MO, COD	AE, V, MC, PC, BC, MO, COD	AE, V, MC, PC, BC, MO, COD	AE, V, MC, PC, BC, MO	AE, V, MC, PC, BC, MO, COD	V, MC, PC, BC, MO, COD	AE, V, MC, PC, BC, MO, COD	V, MC, PC, BC, MO, COD
WARRANTY								
From mail-order house	1 year	1 year	1 year	1 year	1 year	4 months	1 year	None
From drive manufacturer	None	1 year	1 year	1 year	1 year	1 year	1 year	1 year
RETURN POLICY								
Money-back guarantee	○	●	●	○	●	○	●	●
Replacement for defective products	●	●	●	●	●	●	●	●
ORDERING AND SUPPORT								
Ordering hours (EST)	Mon.-Fri., 9:00-7:00; Sat., 10:00-2:00	Mon.-Fri., 9:00-10:00; Sat., 10:00-6:00	Mon.-Fri., 8:30-6:30; Sat., 10:00-4:00	Mon.-Fri., 9:30-9:00; Sat., 11:00-6:00	Mon.-Fri., 9:00-6:00; Sat., 1:00-6:00	Mon.-Fri., 9:00-6:00; Sat., 9:00-5:30	Mon.-Fri., 10:00-6:00; Sat., 11:00-3:00	Mon.-Fri., 6:00-10:00; Sat., 10:00-6:00
Order turnaround time (hours)	24	48	24	48	72	24	24	24
Toll-free technical support	○	●	○	○	○	●	○	○
Technical support hours (EST)	Mon.-Fri., 9:30-6:00	Mon.-Fri., 9:00-6:00	Mon.-Fri., 10:00-6:00	Mon.-Fri., 11:00-7:00	Mon.-Fri., 10:00-7:00	Mon.-Fri., 9:00-5:30	Mon.-Fri., 10:00-6:00	Mon.-Fri., 6:00-10:00; Sat., 10:00-6:00
Number of years in business	5	8	8	3	3	7	5	8

Editor's Choice

● —Yes ○ —No

AE—American Express, V—VISA, PC—personal check, BC—bank check, MO—money order, COD—cash on delivery.

MASS STORAGE
MAIL-ORDER HARD DISKS

be confident about your purchase. If you do return a disk, the company charges a 15 percent restocking fee, unless it was dead on arrival. This is a steep price to pay, especially since the sales representatives don't help to prevent purchase mistakes.

Fast Micro has been in the business for 3 years and it has an unusual pedigree: unlike most of the other companies covered here, which started life as mail-order vendors and then moved into retail, Fast Micro started as a retail operation. In addition to hard disks, the company sells monitors, video cards, modems, printers, some fax machines, laptop computers, and other peripherals and software.

Fast Micro is not the place to turn if you don't know much about hard disks, and certainly not the place to go to get a deal on the Seagate ST251-1, but it is one of the few mail-order houses to carry the Mitsubishi MR535 at a reasonable price. If you're interested in this disk, Fast Micro may be the right place to buy it.

Hard Drive International

Hard Drive International sells only hard disks and related products, a specialization unmatched by any other mail-order company. While such a narrow focus could get a lesser company into trouble, Hard Drive happens to be very good at what it does. Its excellent prices consistently match the lowest prices advertised by other mail-order companies, and the salespeople and tech support personnel are all hard-disk experts.

Talking to Hard Drive International's salespeople is a pleasant experience. They never rush, and they know more about hard disks than any other salespeople I

spoke with. With access to a comprehensive database of computer, hard disk, and controller information, they can check the BIOS and controller your PC currently uses if you tell them its make and year. I tried to stump a salesman by asking what disk to buy for the relatively unknown ITT Xtra/XP system. While he couldn't find that computer in his database, he correctly guessed the controller and hard disk it originally had and knew how to upgrade it.

In addition, the salespeople were able to explain the difference between RLL and MFM interfaces. They could discuss access speed sensibly and were conversant with interleave factors, caching, and mean-time-between-failure rates. When you ask about 40MB disks, information on every one they sell comes up on the salesperson's computer screen. There are 12 salespeople, all of whom have been trained by hard disk manufacturers. The 72 inbound sales lines on the toll-free telephone order number are open from 7:00 a.m. to 6:00 p.m. MST, Monday through Friday, and 11:00 a.m. to 4:00 p.m. MST on Saturday.

Hard Drive is trying to work out a deal with Federal Express to make the last pickup at 9:00 p.m. so that orders taken late in the afternoon can go out the same day. The company now gets most orders out the door within 3 days. With the changes they are making, they hope to ship everything the same day, or at worst, the next day.

The MiniScribe 3053 we got from Hard Drive arrived with the mounting rails, screws, and the faceplate in place. The drive cost \$409, the second-best of the prices quoted for this unit within our review group. The MiniScribe also came with *Disk Manager* for low-level formatting and partitioning of the disk.

Along with the disk came an excellent installation manual—put out by Hard Drive—and a sheet for the MiniScribe 3053, detailing jumper settings and format procedures. The manual covers installation by the type of computer you have, not by hard disk type: the first section is for XT's, and the second section covers the AT and 386 machines. The guide is very well illustrated and quite complete. It tells you how to low-level format and partition the disk using *Disk Manager* or DOS. It also talks in general about using a hard disk and handling drive problems. At the end, you'll find a customer evaluation survey; its inclusion shows Hard Drive's real dedi-

cation to improving service.

Dedication to service is also revealed by Hard Drive's return policy. The company gives a 30-day money-back guarantee, with no explanations necessary. Problem disks will be replaced at any point in the 1-year warranty. On top of that, the company always sends you a new disk, not a repaired one. Your new disk will be shipped back to you the same way you shipped the bad disk in or by a faster method, depending on the circumstances.

OUTSTANDING TECHNICAL SUPPORT

The technical support staff at Hard Drive is excellent. You can get support on a toll call line from 8:00 a.m. to 5:00 p.m. MST, Monday through Friday. Like the sales reps, the support people are trained by hard

**Hard Drive
International's
technical support
staff has a
thorough knowledge
of controllers and
compatibility
issues.**

disk manufacturers at their factories.

Every time I called the support staff they offered a wealth of information on hard disks. They understand the ramifications of different interface schemes, have a thorough knowledge of controllers and compatibility issues, and are able to discuss performance characteristics. I could not dream up one installation question that they couldn't handle.

Hard Drive International has been in business for about 3 years. In that time it has become the largest reseller of MiniScribe drives to corporations and individuals, selling about 3,000 units per month. In all, the company sells about 6,000 drives per month—mostly single units to end users.

In addition to the 40MB MiniScribe we evaluated, Hard Drive carries five other 40MB units: two more from MiniScribe, two from Seagate, and one from Priam. Its

PC FACT FILE
EDITOR'S CHOICE

Hard Drive International
1208 E. Broadway # 10, Tempe, AZ 85282; (800)
234-DISK; (602) 967-4999.
List Price: MiniScribe 3053, \$409.
In Short: Hard Drive International is dedicated to the hard disk market as well as to customer service. With some of the best MiniScribe prices, a no-questions-asked money-back guarantee, and a sales staff well-versed in technical details, this mail-order house is unbeatable.

CIRCLE 542 ON READER SERVICE CARD

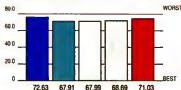


BENCHMARK TESTS: MAIL-ORDER HARD DISKS

DOS File Access (Small Records)

Elapsed Time (seconds)

The DOS File Access (Small Records) benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. The test is performed without software disk caching. Fast times are advantageous for programs that work with many short segments of data.

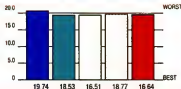


PC Labs' benchmark tests show little difference in performance among the leading 40MB hard disks. When you are buying a hard disk by mail, price and service policies should be your primary concerns.

DOS File Access (Large Records)

Elapsed Time (seconds)

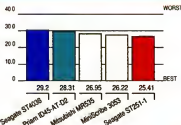
The DOS File Access (Large Records) benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. This test minimizes the effect of small hardware caches on disk subsystem performance. It is performed without software disk caching. Fast times are advantageous when large files are loaded.



BIOS Disk Seek

Elapsed Time (milliseconds)

The BIOS Disk Seek benchmark test measures mechanical track-to-track disk drive access times. Fast times are helpful with programs such as databases, which often store and must later find data in many separate places on a drive.



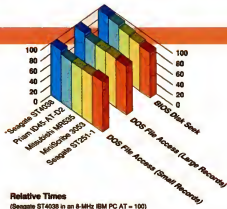
*This product was not obtained from one of the vendors we reviewed, but we are reporting its test results for comparison.



DISK BENCHMARK TESTS: COMPOSITE VIEW

Sample benchmark-test results from one disk of each type acquired from the mail-order companies were compared with results from the Seagate ST4038, the standard hard disk model found in an 8-MHz IBM PC AT.

We found overall variances from a maximum of roughly 13 percent to a minimum of about 2 percent (the Seagate ST251-1 shaves 12.98 percent off the Seagate ST4038's score on the BIOS Disk Seek test and 2.2 percent off its score on the small-record DOS File Access test). Thus, our benchmark tests show that there is little practical difference in performance among the leading 40MB hard disks. If you're comparing these four brands through mail order, concentrate on price, compatibility, and service guarantees. Performance won't be the determining factor.



Relative Times

(Seagate ST4038 in an 8-MHz IBM PC AT = 100)

prices on the Seagate ST251-1 and the Priam ID45 were equal to or better than the best prices from other mail-order companies we reviewed. Additionally, Hard Drive says that it will match any advertised price. When you combine this pricing policy with the superb service and support the company provides, you have some very compelling reasons to buy from Hard Drive International.

PC Connection

PC Connection (established in 1982) is located in the small town of Marlow, New Hampshire (population 600), and it shows—in all the right ways. The unhurried pace of small-town life is made apparent by salespeople who take their time explaining products; no one is in a rush to get you off the phone. The tech support people handle returns and service on a case-by-case basis.

The company concentrates on after-market sales of items such as peripherals and add-ons. PC Connection also carries over 1,000 software titles, but the only computers it sells are laptops. The sales staff has access to a product and inventory database; they keep abreast of most product lines by evaluating hardware and software on their own PCs. Every week a sales meeting is held, during which products are discussed and demonstrated by company employees. PC Connection also invites vendors to teach its salespeople about their products.

SEAGATE EXPERTS

When it comes to hard disks, the sales representatives are very knowledgeable about the Seagate line. That's fitting, as PC Connection carries only Seagate disks: 20-, 30-, and 40MB disks for XT-class computers,

and two 40- and one 80MB disk for AT-class machines. The advice I received was practical, not pushy, and the salesperson was attentive to my needs. The sales staff knows what disks will work in IBM machines and major brand-name compatibles, but that's it. If you have a less popular computer, the sales staff may not be able to help you; they will recommend that you speak directly with Seagate or the computer manufacturer.

After placing an order on PC Connection's toll-free line, your product will be shipped UPS ground or optionally by Airborne on the same day. The only unacceptable payment method is American Express.

The Seagate ST251-1, the faster of the two 40MB disks PC Connection sells for the AT, costs \$449—a good but not great mail-order price, and equal to what Fast Micro and Shamrock charge. The disk comes with the usual set of rails, screws, and cables. The only documentation accompanying it is Seagate's Universal Installation Handbook, which is brief but adequate. The hard disk also comes with *Disk Manager*, to take care of the low-level format and partitioning. A hard disk error map is taped to the top of the disk, and a factory test sheet using the Wilson Disk Tests is enclosed.

PC Connection is installing more trunk lines so that a smaller percentage of calls will get busy signals on the company's toll-free technical support line. Getting through to the technical support staff is almost worth the wait, though, since they are congenial, knowledgeable, and able to handle just about any installation question that you might have.

PC Connection doesn't offer a money-back guarantee, and if you change your mind about a disk, you may be charged a 15 percent restocking fee. Of course, the company honors the 1-year warranty offered by Seagate: in the early days of the warranty, defective disks are replaced with new ones. Later you will probably receive a repaired disk the same age as the defective unit. The company will match the shipping method you used to send in the bad hard disk. In some cases, a replacement hard disk will be sent to the customer even before the original disk is returned. All matters relating to service fulfillment are at the discretion of the technical staff, which has complete autonomy within the bounds of the warranty.

Shamrock

Shamrock is a division of Franklin Telecommunications, a large national distributor of computer products. Shamrock itself has a small, dedicated, and experienced sales force. Seagate hard disks are one of the division's primary items. In fact, there is a Seagate repair facility on Franklin's premises.

The salespeople at Shamrock can be reached by a toll-free telephone number Monday through Friday from 7:00 a.m. to 5:00 p.m. PST and on Saturday from 9:00 a.m. to 1:00 p.m. That is, if you don't get a busy signal. Shamrock doesn't use an answering system, so it can be hard to get through. I once tried calling for 13 minutes and finally gave up. When you do get through you can be put on hold for 10 minutes or more.

When I did reach the salespeople, they were extremely knowledgeable and friendly. They knew enough to ask a customer about his or her application use before recommending a hard disk. They also knew what hard disks work with which controllers and could discuss the trade-offs between access speed and price. Advice was given freely and without any rush toward a sale.

Hard disks can be paid for by any of the customary means, but there's a surcharge of 3 percent for using American Express. Products are shipped UPS ground. If the customer wants to pay the difference, Shamrock will ship by Federal Express. Orders go out on the same day if they are placed in the morning; afternoon orders ship the next day.

We received the Seagate ST251-1 from Shamrock. It cost \$449, the highest price for that model in our group of mail-order companies (the same price that PC Connection and Fast Micro offer). But, in addition to coming with *Disk Manager* from

PC FACT FILE

PC Connection
6 Mill St., Marlow, NH 03456, (800) 243-8088,
(603) 446-7721.
List Price: Seagate ST251-1, \$449.
In Short: When it comes to hard disks, PC Connection specializes in Seagates. It uncovers individual attention, accurate information, and reasonable prices are important to you. PC Connection fits the bill.

CIRCLE 543 ON READER SERVICE CARD

PC FACT FILE

Shamrock
733AA Lakeland Rd., Dept. P, Westlake Village, CA 91361, (800) 722-2898, (805) 373-8688.
List Price: Seagate ST251-1, \$449.
In Short: Although Shamrock's pricing is often relatively high, it offers an unusually flexible return policy, extra software, and excellent sales and technical support.

CIRCLE 544 ON READER SERVICE CARD

Before Hiring A Project Manager, It's Wise To Check References.

*"There's little else
you can ask for amidst
its barrage of options
and features."*—Lamont
Wood, November 1988.

BYTE



*"Editor's
choice. An
extremely flexible
program, rich in
ways to view
a project."*—
November, 1988.

SUPERPROJECT

**COMPUTER
ASSOCIATES**
Software superior by design.

*"We have rated SuperProject
as the number one package
in the under \$1,500 cost
category."*—Daniel
Yahdavi, 150ft Decision,
Inc., October, 1988.

*"In features
and capacity
SuperProject Expert
leads the pack."*—
Woody Liswood,
November, 1988.
PC WORLD

It isn't an easy thing choosing project management software.

Countless programs and features can make the task downright daunting.

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Or, more to the point, we'd like to introduce some people who can: the editors and critics of some of the most prestigious computer magazines.

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SuperProject Plus®, Expert and Expert/2 for OS/2 offer comprehensive control over the smallest to most complex projects. You can

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And that's the kind of advantage that comes only from the world's leading independent software company.

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Do they call it a h it's so hard to find wh



You're looking for a specific piece of information on your PC. But you can't remember which memo, spreadsheet or even which file it's contained in.

And you're certainly not about to

search through each directory, much less load and unload every file to find it.

That's why we created Magellan®. The first utility that helps you find your files by letting you instantly see their contents as

ard disk because at you're looking for?

they appear in your favorite applications.

Without even having to load the specific applications that created the file.

With Magellan, all you need is a general idea of what you're looking for.

Because unlike other programs, the Magellan Explore function can perform a search on a phrase, a topic, an idea or even an entire file. Not just key words.

Then it lists your "found" files on the left of your screen in order of how relevant the contents are to the search topic.

As fast as you can scroll down this list, the Magellan SpeedView function instantly displays the complete contents of each file on the right of your screen, highlighting the relevant text for you.

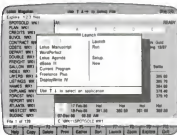
Using the information is easiest of all. Because all it takes is one keystroke to launch into the application that created the file, and it'll be loaded and ready to go.

Or you could use Magellan to gather the

information you choose from several different applications (like a 1-2-3® spreadsheet and a WordPerfect® memo)¹ and put it into a single file so you can start using it right away.

Best of all, you're productive literally

five minutes after installing Magellan. The menus are intuitive, and everything you need to run the program is on the screen right



With one keystroke, Magellan loads the selected file and application, in this case 1-2-3, so you're ready to go to work.

in front of you. Which means that there is virtually no learning curve.

Call 1-800-345-1043 for your free Magellan demo kit. Ask for ALJ-3593 to learn more on why Magellan is the quickest, easiest way to access all the information on your hard disk.

That way, you can spend time working with information, instead of just looking for it on your PC.



Introducing Lotus Magellan

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THE HARD DISK MARKETPLACE

Before you start calling, prepare yourself with this list of models and specifications.

by Henry Fersko-Weiss

When you explore hard disk mail-order offerings in the sub-80MB range, you'll find that Seagate dominates the market. Of the eight companies we evaluated for this story, three sell no hard disk brands other than Seagate. The other five companies all sell more Seagate hard disks than any other 40MB brand. Four of them sell the next most popular brand, MiniScribe, and a smattering of other brands appear in the mail-order catalogs.

The two most common Seagate hard disks are the ST251 and the ST251-1. Both are half-height models that format to 42MB. The ST251 has an average access time of 40 milliseconds, while the ST251-1 runs at 28 ms. The companies we called charged prices ranging from \$329 to \$399 for the ST251, and from \$389 to \$449 for the ST251-1.

One mail-order company sold the Seagate ST157R, a 3½-inch RLL-encoded drive that formats to 50MB and runs at 30 ms.; it was quoted at \$399. Another company sold the ST251N, a SCSI interface drive that formats to 43MB, runs at 28 ms., and costs \$449.

The two most prevalent MiniScribe hard disks were the 3650 and the 3053, both half-height models. The 3650 formats to 42MB and has an access speed of 61 ms. Its price ranged from \$299 to \$319. The 3053 formats to 44MB and has an access speed of 25 ms. It had a somewhat wider price range, from \$399 to \$459.

A third MiniScribe, the 8450, is a 3½-inch drive that formats to 42MB, runs at 45 ms., and costs about \$290. The last MiniScribe we encountered repeatedly was the 6053. Although it's no longer being manufactured, the 6053 is still sold through several mail-order companies. It is a full-height disk, with a formatted capacity of 44MB, running at 28 ms. Its mail-order price was quoted at \$506, but since it is a discontinued model, you might be able to haggle it down. The 3053 replaces it in MiniScribe's product line.

Only one other brand of hard disk was sold by more than one of the companies we looked at: Priam. Its half-height ID45 formats to 44MB and runs at 28 ms. It was quoted at \$429 and \$449.

We encountered three other hard disks for AT-class machines, each sold by a different company. One of them, the 28-ms. Conner Peripherals SCSI 40MB disk, is sold principally for Compaq machines and costs about \$565. The second—the Mitsubishi MR535—formats to 42MB, has an access time of 28 ms., and sells for \$399. The third disk is the full-height Micropolis 1333A, which formats to 44MB, runs at 30 ms., and is priced around \$649.

Though quite a few other 40MB hard disks are manufactured, they don't sell in large enough quantities to encourage mail-order companies to stock them. The bottom line: expect Seagate or MiniScribe, and always compare prices.

Model	Formatted capacity	Access time	Disk size
MiniScribe 8425	21MB	68 ms.	HH
MiniScribe 84255	21MB	68 ms.	3½
MiniScribe 9428F	21MB	40 ms.	3½
Seagate ST225	21MB	65 ms.	HH
Seagate ST225N	21MB	65 ms.	HH
Seagate ST125	21MB	28 ms.	3½
Seagate ST125A	21MB	28 ms.	3½
Seagate ST125N	21MB	28 ms.	3½
MiniScribe 8438	30MB	68 ms.	3½
Seagate ST238R	32MB	65 ms.	HH
Seagate ST138	32MB	28 ms.	3½
Seagate ST138A	32MB	28 ms.	3½
Seagate ST138N	32MB	28 ms.	3½
Seagate ST138R	32MB	28 ms.	3½
MiniScribe 3650	42MB	61 ms.	HH
MiniScribe 8450	42MB	45 ms.	3½
MiniScribe 8051A	42MB	28 ms.	3½
Seagate ST250R	42MB	70 ms.	HH
Seagate ST251	42MB	40 ms.	HH
Seagate ST251-1	42MB	28 ms.	HH
Seagate ST151	42MB	24 ms.	3½
Seagate ST157A	43MB	28 ms.	3½
Seagate ST251N	43MB	28 ms.	HH
MiniScribe 3053	44MB	25 ms.	HH
Priam ID45	44MB	28 ms.	HH
Priam ID45-AT-D2	44MB	23 ms.	FH
MiniScribe 8051S	45MB	28 ms.	3½
Seagate ST157R	50MB	30 ms.	3½
Seagate ST157N	50MB	28 ms.	3½
Priam ID60-DP-D1	60MB	23 ms.	FH
Seagate ST177N	60MB	24 ms.	3½

FH—full-height 5¼-inch

HH—half-height 5¼-inch

3½—half-height 3½-inch

Ontrack—as all Seagate disks do—it was accompanied by *TakeTwo Manager*, a backup program from United Software Security (and a former *PC Magazine* Editor's Choice). The drive also comes with *LepreCache*, a disk cache utility. The program is Shamrock's version of *PC-Kwik* from Multisoft Corp.

The hard disk comes with the usual installation hardware, and the installation guide comes from Shamrock. It's illustrated and covers the basics without getting very detailed. The hard disk comes low-

**Shamrock offers a
flexible 30-day
money-back
guarantee that, in
some cases, can be
extended to 40 or
50 days.**

level-formatted and partitioned. The instructions in the installation guide suggest using *Disk Manager* only if the disk doesn't respond. The Guide tells you how to load the *LepreCache* utility. A regular *TakeTwo Manager* manual is also included. The hard error map is taped to the top of the disk, and the disk type appears on a side panel. There's no factory test sheet.

RETURNS AND REPAIRS

Shamrock offers a money-back guarantee for 30 days. In some cases the company

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will even stretch that guarantee to 40 or 50 days. Bad disks are generally replaced with new ones, because Seagate commonly sends a new one to Shamrock. Sometimes bad disks are replaced with repaired drives of equal or younger age.

When Shamrock gets back a problematic disk, it tests it in a PC, and then, if necessary, in a Wilson test machine. If a board-level repair can fix the problem, the disk is sent to the Seagate repair facility at Franklin; otherwise, it's sent back to Seagate's main repair facility in Florida.

The tech support at Shamrock is very good. It can be reached from 8:00 a.m. to 5:00 p.m. PST, Monday through Friday. My questions were handled quickly and courteously—even when I played the part of a totally baffled user, the support person was patient and led me through the installation from start to finish.

The Shamrock division of Franklin was created in the fall of 1986. It sells to end-users many of the same products that Franklin sells to retailers. All told, Shamrock carries about 250 hardware products. With the wholesale division of Franklin, Shamrock maintains about \$3 million in product inventory, which makes it unlikely that the company will be caught short on important stock items.

At the 40MB capacity, Shamrock sells only one other brand of hard disk: Micropolis. The Micropolis model 1333A is full-height and has an average access speed of 28 ms. Shamrock sells the disk for \$649—its high price tag is due to its excellent mean-time-between-failure rating: 25,000 hours.

Zeos International

Although Zeos International isn't new to the PC industry, it is new to the mail-order business. In 1987 Zeos started accepting mail orders for its computer systems. Since then it's been gradually expanding its mail-order business, selling only the components and peripherals used in its computers. The company is just now beginning to sell parts to non-Zeos computer users, but it's already doing many things right. It has knowledgeable sales and tech support people, great order and tech support hours, fast turnaround, a money-back guarantee, and excellent prices.

Zeos has the best order and tech support hours of any other mail-order company in

our review group. The lines are open for 14 hours each weekday, on Saturday for 8 hours, and on Sunday for 7 hours (the only Sunday hours in this group of companies). Weekend tech support hours are a big plus.

When you call Zeos (toll-free), you reach an automated attendant. Then by pressing the right buttons, you can get to the sales department or tech support. You rarely get a busy signal, but you may have to wait to get through to a representative. The salespeople assume you have a Zeos system when you inquire about hard disks. One salesman even told me that the company doesn't sell parts to people without a Zeos computer. Obviously, the salespeople are still adjusting to the shift to general mail-order business. At present, only 20 percent of Zeos's mail-order sales are to non-Zeos users. Once you get past this, the salespeople will ask questions about your needs. I found them prepared to discuss access speeds, interfaces, and the merits of different brands of hard disk.

METHODS OF PAYMENT

Zeos ships all orders placed before 1:00 p.m. the same day; orders made after that get shipped the next day. The company won't accept American Express, and orders paid for by personal check have to wait for clearance—up to 2 weeks. Orders are shipped via UPS. For normal handling and ground service you pay \$5; overnight delivery costs \$15.

Hard disks can be ordered preformatted and partitioned, but this convenience costs \$25 extra. Some of the other mail-order companies do the formatting without charging for it. Low-level formatting is easy to do using *Disk Manager*, which Zeos includes with its drives, so there's no need to have Zeos do it for you.

We received both a Seagate ST251-1 and a MiniScribe 3053 from Zeos. Each

drive costs \$399. This price for a Seagate matched the lowest price we were quoted, and the MiniScribe price was the absolute lowest we found.

Both disks arrived with mounting rails, a faceplate, mounting screws, and a data cable. The only documentation for the Seagate was Seagate's own pamphlet.

The MiniScribe disk came with three manuals. The basic installation instructions are contained in a four-page pamphlet with just two illustrations. A technical support manual covering three MiniScribe models (including the 3053),

**Zeos International has
the best order and tech
support hours of any
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gives formatting and partitioning instructions for various controllers and tells you how to use *Disk Manager* and DOS for partitioning. A product manual tells you all about the 3053 from the electrical interface to its functional characteristics.

If you run into problems installing either one of the disks, Zeos's tech support people can help you. Because they all have experience putting systems together, they have tested disks and know many of the problems firsthand. They were able to solve any problem I posed, including a dead disk. I was given a return authorization number immediately. I sent the disk back to them with Federal Express's overnight service and received a replacement drive 2 days later—also shipped via Federal Express. Zeos will always match the method of shipment a customer chooses.

Zeos offers a 30-day money-back guarantee, and nothing has to be wrong with the disk to take advantage of the offer. If a disk develops problems anytime during the 1-year warranty period, Zeos will send a new disk or one that was returned during the 30-day guarantee period for reasons other than defective operation. To handle the demand for hard disks, Zeos maintains about 2 weeks of inventory.

Although Zeos is very new to the general mail-order business, it understands how



FACT FILE

Zeos International
530 5th Ave. NW, St. Paul, MN 55112; (800) 423-5891.
List Price: MiniScribe 3053, \$399; Seagate ST251-1, \$399.
In Short: New to the mail-order industry, Zeos enters with style, offering courteous service, competent support, and competitive prices on a variety of disks.

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CIRCLE 136 ON READER SERVICE CARD



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On guard with Mace Gold you have, foremost, *Mace Backup*, a fast, convenient, fail-safe way to save and restore hard disk data. *Remedy* stands in reserve, ready to find and automatically fix the inevitable weak spots on your disk before they can threaten valuable files. *POP*, our power-out protection software, can carry you past brown-outs, black-outs and keyboard lock-ups. And *Vaccine* stands as a final line of defense against "bombs," "viruses," and the odd "trojan horse."

No defense is perfect if it can't recover, and Mace Gold provides what you would expect, the best data recovery there is. *UnDelete* and *UnFormat* offer flawless recovery of deleted files and entire disks. *TextFix* and *dBFix* go beyond simple ASCII retrieval to automatically find and rebuild lost, corrupted or damaged word processing and dBase files without losing precious format information. And now

there's *MUSE*, a sector editor intelligent enough to teach you, and packed with enough recovery power to resurrect the "deadest" of disks.

Of course, the best defense is still a strong offense, and Mace Gold gives you just what you need to keep your system moving fast and efficiently. With fast disk caching in regular, extended or EMS memory, quick and reliable file consolidation with *UnFrag*, and directory sorting and squeezing, Mace Gold can minimize wear and tear on your disk—and your fighting spirit.

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CIRCLE 236 ON READER SERVICE CARD



EDITOR'S CHOICE

- CompuAdd
- Hard Drive International

Both our own investigation and a PC MagNet survey of over 400 readers show that ordering hard disks by mail can be easy and inexpensive if you invest a little time and use some common sense.

Keep in mind that everything we've said about buying hard disks for AT-class machines goes for PCs, XT's, and 386-based machines as well. Except for some arcane compatibility issues, it doesn't really matter whether the disk you buy is a Seagate, a MiniScribe, or a Priam, but make sure you get one with an access time of 28 ms. Think about buying a disk bigger than 40MB, especially if you think OS/2 is in your future. The bigger the disk, the more likely you'll be entering the more-expensive worlds of ESDI and SCSI.

If you're dealing with a mail-order company for the first time, pay with a credit card, and remember that you probably don't have to replace your controller (unless you want to try a new interface).

You should strive to find the mail-order company that gives you the best combination of price and service. Though the majority of companies we evaluated have knowledgeable salespeople and are price-competitive, CompuAdd and Hard Drive International stand out. CompuAdd is the giant of mail order, and even though its prices aren't the best, the amount of service, support, and extra software (like *PC-FullBak*) you get is impressive. Hard Drive International, specialist that it is, has the smartest salespeople we talked to and prices that are competitive across the board.

important service and support are and offers terrific prices. It's hard to find a better combination anywhere else. As Zeos gets more used to dealing with non-Zeos computer users, it will be an even better source to buy from. ■

Henry Fersko-Weiss is a frequent contributor to PC Magazine.



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1024K, 1.2MB or 1.44MB Drive, 101-Key Board

Standard System Features:

- Intel 80386 Processor Operating at 20MHz with Zero Wait States in Interleave mode delivering 30MHz Effective Throughput
- 1024K RAM standard expandable to 16MB via 32Bit RAM boards using 256K and/or 1MB 100ns RAM chips
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
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1024K, 1.2MB or 1.44MB Drive, 101-KeyBoard

Standard System Features:

- Intel 80386 Processor Operating at 25MHz with Zero Wait States in interleave mode delivering 35MHz Effective Throughput
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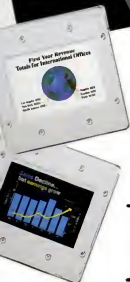


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CIRCLE 472 ON READER SERVICE CARD

Fine Lines: The PC As Illustrator

by Isaac Victor Kerlow

The best vector-based illustration packages for the PC now approach the quality of those that have been available on the Macintosh for some time. *PC Magazine* evaluates *Adobe Illustrator*, *Corel Draw!*, *GEM Artline*, *MASS-11 Draw*, and *Micrografx Designer*.

Distinctions among various types of PC-based graphics programs are sometimes very blurry. You can find different types of programs in a spectrum that ranges from simple paint programs that create bitmapped images, presentation graphics packages that specialize in constructing charts for slide shows and reports, vector-based (or object-based) illustration packages that help you create freehand illustrations and drawings of great complexity, and traditional CADD packages for architecture and engineering applications.

The five illustration programs reviewed here—*Adobe Illustrator*, *Corel Draw!*, *GEM Artline*, *MASS-11 Draw*, and *Micrografx Designer*—are all vector-based. Priced between \$495 and \$695, they differ from paint programs and business graphics programs in important ways. In particular,

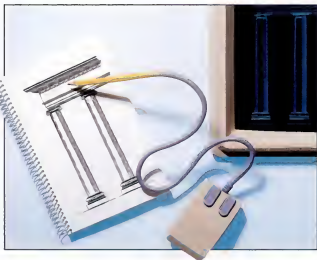
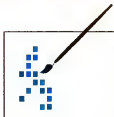


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A QUICK GUIDE TO PC GRAPHICS

The world of graphics is a complicated one. Here are its seven main continents.



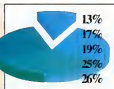
PAINT PROGRAMS

Paint programs are for rough sketches, freehand drawings, or modification of scanned (TIFF) images for desktop publishing. They produce bitmapped images, which degrade when enlarged and have device-dependent resolution. Images are easily editable at the pixel level, and file size grows with image size. Most of these programs generate files in .PCX format. Examples: *PC Paintbrush*, *Publisher's Paintbrush*, *Windows Paint*.



ILLUSTRATION/DESIGN SOFTWARE

This type of software produces vector-based images. Curved line-drawing tools are an advantage found in these programs. Sophisticated color models are often available for the creation of camera-ready color separations. The popularity of these packages is growing relative to that of paint programs, because output is device-independent (image resolution can be as high as the output device allows). Programs generate a number of proprietary file formats. .CGM (Computer Graphics Metafile) is a strong candidate for the object-based standard image file format. Examples: *Adobe Illustrator*, *Corel Draw!*, *GEM Artline*, *MASS-11 Draw*, *Micrografx Designer*.



PRESENTATION GRAPHICS SOFTWARE

Presentation graphics packages help the nonartist create good-looking text, data-driven graphs, and simple diagrams. Charting is linked to numeric data (often imported from spreadsheets). Some packages include graphics primitives (arrows, boxes, lines), and some offer clip-art libraries to supplement diagrams and charts. Editing, moving, and resizing is easy. Packages support a variety of output devices, including film recorders, plotters, laser printers, color printers, and slide service bureaus. Examples: *Freelance Plus*, *Graph Plus*, *Harvard Graphics*.

Desktop presentation packages are offshoots of presentation graphics that stress the concept of a total presentation. They include the ability to sequence slide shows on a monitor and to prepare speaker notes and audience handouts. Some graphics packages (*Freelance Plus*, *Harvard Graphics*) are addressing this need with slide-show utilities, but right now, with the exception of *Xerox Presents*, the Mac's *Microsoft Powerpoint* and *Aldus Persuasion* have no PC peers.

vector-based programs are extremely capable when it comes to handling most of the hard-edge illustration tasks graphic artists have traditionally done by hand using technical pens, french curves, and transfer screens. They do, however, take on some of the characteristics of CADD packages.

WHAT THEY AREN'T

Illustration programs are not paint programs, and here's why. Bitmap-based paint programs let you create an illustration pretty much the way you would using

traditional painting tools like pencils, pens, brushes, and, of course, paint. These programs make it possible to simulate the rich, uneven textures or colored brushstrokes of watercolors or oil paintings. At its simplest level, the illustration you create is composed of a matrix of pixels called a *bitmap*, in which each pixel has an intensity or color value assigned to it.

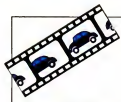
Unfortunately, bitmaps degrade as you enlarge them, while vector-oriented packages create drawings that are more like CADD images; they "stretch" as you en-

large them, maintaining their resolution and ratios at any size. Since lines in vector-oriented software are mathematically defined, they have no specific incarnation: they have no resolution, no width, no color. Such lines (or paths) are in effect device-independent.

Even fuzzier is the line between vector-oriented illustration software and computer-aided design and drafting (CADD) programs, most of which are also vector-oriented. Sometimes it's only the type of functionalities each program has—and its

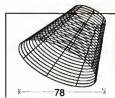
ANIMATION SOFTWARE

These programs link, chain, and sequence multiple graphics to create desktop videos. All have transitional screen dissolves (wipes, fades) that you can design and direct. Packages include scripting languages that let you create the illusion of movement; they also include simple graphics tools to create images. Screen captures from other sources can be modified and sequenced as well. The results are shown on a monitor, sent as a demo or tutorial disk, or used on a laptop during a sales call. Examples: *PC Storyboard Plus*, *Show Partner FIX*, *VCN Concorde*.



CADD SOFTWARE

As technical cousins of vector-based design software, CADD (computer-aided design and drafting) packages are primarily used in the fields of architecture, engineering, industrial design, and facilities management. Auto-dimensioning, 3-D capabilities, shading, and solid modeling are some of the high-end features that make CADD stand apart from illustration packages, though many CADD images can be exported to illustration packages for further editing, or to desktop publishing documents. Examples: *AutoCAD*, *Cadkey*, *Generic CAD*.



DESKTOP PUBLISHING

DTP packages import graphical images created elsewhere and surround them with text to create complete fliers, newsletters, advertisements, and books. These packages can import all common graphics types, and they have some ability to modify and size graphics directly. Examples: *IBM Interleaf Publisher* (which includes built-in charting and illustration tools), *PageMaker*, *Ventura Publisher*.



OTHER GRAPHICS TOOLS

Clip-art libraries contain files of professionally created illustrations and are available in both bitmapped and object-based formats from a number of vendors. Some packages, like Computer Support's *Arts & Letters*, offer extensive editing capabilities, while others, like *ImageBase*, offer images that aren't meant to be edited.

Screen capture software grabs the image on-screen from video memory for insertion into a document, for output to a high-quality device, or for modification. Examples: *Collage*, *Hotshot*, *Pixel Pop*.

File conversion software translates one graphics format into another to move images among graphics programs—for instance, between vector-based and pixel-based packages. Examples: *Hijack*, *Passport*.



specific applications—that separate these two categories.

CADD drawing tools are usually inflexible, while the drawing tools in illustration programs are generally easy to manipulate without following a rigid grid. Printing options in CADD programs are usually set up so that final output is done on pen plotters or devices that imitate the style of pen plotters. The final output of an illustration program is usually produced on high-resolution raster (vector) devices like laser printers—especially PostScript laser

printers—and typesetting equipment. Most object-based illustration programs also offer some kind of graphic arts color separation technique, be it CMYK (cyan, yellow, magenta, and black) or the Pantone Matching System, and their text tools include many of the functions of a typesetting system.

TECHNICAL ILLUSTRATIONS

Think of a technical illustration with its smooth curved lines fitting perfectly into each other, airbrushed color gradations,

and precise shapes. Using vector-oriented programs is very similar to making a collage out of paper cutouts: each element (lines, shapes, letter forms) is an independent object with its own attributes, and elements overlap each other.

One of the most distinctive characteristics of vector-oriented programs is the way in which lines are defined. Instead of creating an entire line by drawing continuously—the way you would with a paint program—you lay down discrete points, *anchor* and *control points*; these control

the length and curvature of line segments. As you lay out the control points, the program creates a mathematically defined (Bezier) curve, a "path" that connects the points to one another. A set of secondary control points, called *tangent points*, is available in most programs for further refinement and control of the path's curvature and tension.

The real power of a vector-oriented program lies in its ability to manipulate a drawing by maneuvering a curve's control points. This technique lets you create an infinite number of variations on an original drawing in a relatively short time.

MAC ORIGINALS, PC UPSTARTS

Except for some CADD software, the Apple Macintosh environment was once the place to find object-based programs. Some of the initial Mac contenders have come and gone, but the two best-known object-based illustration programs that remain in the Mac arena are Aldus's *FreeHand 2.0* and Adobe Systems' *Illustrator 88*. In their current versions, both of these programs are very powerful design and illustration tools.

During the last 2 or 3 years, vendors in the graphics industry have ported object-based illustration products from the Macintosh to the PC environment with varying degrees of success. Adobe's *Illustrator* was the first major Mac illustration product to find a home on the PC; unfortunately, it lost much of its functionality (at least in Version 1) and much of its appeal during the trip. Will Aldus try to bring its successful *FreeHand* package over to the PC environment? It hasn't yet, but it should.

Many PC CADD programs were converted from or upgraded to illustration programs. *Micrografx Designer* and *MASS-11 Draw*, for example, seem to have their roots in early CADD models, but today they both have illustration features. Some new PC illustration programs were created from scratch, like the recently introduced *Corel Draw!* and *GEM Artline*.

The five programs reviewed here share many similar features. Each may lay claim to outshining its competition in one respect or another, but in general, their richness in functionality and performance is slowly approaching the standard that users in the Macintosh environment have come to expect. The bad news is that none of them has quite reached that standard yet.

In terms of ease of use and interface techniques, most of the programs reviewed here fare well, though *MASS-11*

Draw has a pre-Macintosh look and feel that is more akin to that of a CADD program, and *Designer* can be complex to work with.

All the programs have the basic curve-drawing and editing tools, as well as the basic transformation and viewing tools (translating, moving, scaling, slanting, and zooming in). Some of these programs let you do all transformations through the keyboard—a must to achieve precision.

Control over type styles is very uneven in this software category. *GEM Artline* and

Before making a buying decision, consider the kind of illustrations you need to draw.

Corel Draw! give you almost absolute control over kerning, manipulating letter forms as paths, filling them with patterns, or aligning them along another path—unlike the other packages.

Color and pattern manipulation is another area where the packages are not equal. *Adobe Illustrator* and *MASS-11 Draw* do not support on-screen color at all. Some of the programs that do offer color are limited to one model, while others can operate in a variety of color models. *Corel Draw!*, for example, gives users the option of working with CMYK, HSL (hue, saturation, and lightness), RGB (red, green, and blue), and Pantone (spot-color) color systems. *MASS-11 Draw* and *Micrografx Designer* offer a wonderful array of patterns plus powerful editing tools.

All the programs reviewed here can do automatic tracing of an imported bitmap file. This vital feature allows any bitmapped image from a scanner or a paint program to be transformed into an object that can be manipulated by an illustration program. Most of the packages accept a variety of file formats for input, and many include conversion utilities.

Micrografx Designer also has the ability to print an alphanumeric list of all elements used in an illustration. And *Corel Draw!* lets you copy attributes between objects and set up text style sheets.

ASSESSING YOUR NEEDS

When it comes to making a buying decision, first consider the kind of illustrations you need to draw and the tools you'll need for creating them. Think about the file formats you must import and the formats you want to end up with. You also might want to assess whether an extensive collection of clip art is important to you. *Designer* excels in this category, and other specialized products like *Arts & Letters* from Computer Support Group offer thousands of clip-art images. (*PC Magazine* has planned a review of clip-art libraries for a future issue.)

If your application is somehow related to CADD activities, then turn to one of the two packages that have their origins in that area: *MASS-11 Draw* or *Micrografx Designer* (the latter even handles auto-dimensioning—the ability to calculate and display the length of a line). If auto-tracing is important to you, *Adobe Illustrator*, with its excellent auto-trace utility, could prove a good choice. If your application demands superb color and type control, then *Corel Draw!* or *GEM Artline* are the obvious winners. *GEM Artline* is also the perfect candidate when compatibility with the very popular *Ventura Publisher* is a concern, since both run under Digital Research's *GEM* environment.

LOOKING AHEAD

The future of illustration software for the PC is bright. Even some business graphics programs like Lotus' *Freelance Plus 3.0* (released last fall) and *Micrografx's Draw* and *Graph Plus* (a graphing cousin to *Designer*, with many of its drawing abilities) are getting into the drawing act. For instance, the new version of *Freelance Plus* will support Bezier curves; import TIFF images that can be flipped, rotated, and sized; and offer a WYSIWYG preview.

As for PC-based, object-oriented drawing software, the number of products is still small, and the field is wide open. The lack of illustration facilities in desktop publishing programs (as well as the ever-increasing importance of PC-based DTP in professional publishing houses and corporations) is just one reason why you can expect to see more object-oriented, hi-res illustration programs in the near future. The emergence of the \$2,500 *IBM Interleaf Publisher*, which combines desktop publishing and illustration tools in one extremely powerful package, may be a sign of things to come (see "Interleaf: The Industrial-Strength Publisher," *PC Maga-*

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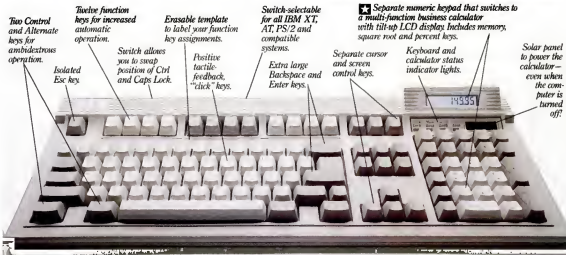
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GRAPHICS ILLUSTRATION SOFTWARE

zine, December 27, 1988). The growing desire to make use of the cost-effective, microcomputer-to-high-end typesetting machine connection, which object-oriented illustration software often ably supports, will also help rush development in this market.

What it all boils down to is this: Increasingly sophisticated illustration packages will continue to take the place of conventional drawing tools. As improvements evolve in such areas as spot-color display and separation, text manipulation, and image importation, graphic arts will move even further away from the T-square and closer to the PC.

Adobe Illustrator

by Isaac Victor Kerlow

Adobe Illustrator, \$695 from Adobe Systems, can handle many of the illustration tasks traditionally done by hand with tools like technical pens, french curves, transfer screens, and patterns like those manufactured by Letraset. *Illustrator* can also be used for turning scanned bitmap images into vector-based objects and for converting *AutoCAD* files into Encapsulated PostScript (.EPS), a format compatible with most desktop publishing programs.

PAST HITS, PRESENT MISSES

Adobe Systems has an excellent track record in the world of desktop publishing and illustration software. Adobe was the original developer of the PostScript page description language, the standard in the world of electronic publishing and color separation. The company also developed the Adobe Type Library, high-quality digital versions of a number of classic typefaces, and *Adobe Illustrator 88*, the Apple Macintosh version and predecessor of the PC product.

Here comes the disappointment: the first PC version of *Illustrator*, which runs under *Microsoft Windows* (a runtime version of *Windows* is included), is not nearly as powerful as its Macintosh cousin. Many of the features that made the program so successful on the Mac are missing from the PC version. The dimensioning tool, for example, which puts measurements along the edges of a drawing (à la CADD), has been left out. (*Micrograph Designer* is the only product evaluated here that does have dimensioning capabilities.) A clipping function that would allow you to perform

Boolean-type operations on shapes is not yet available either.

Mac-implemented features like on-screen color and pattern support (a must by today's graphic arts professional standards) are also nonexistent. The popular HSL (hue, saturation, lightness) color model is missing, as are the RGB (red, green, blue) and Pantone color systems. You can get full color output only if you have access to an expensive color PostScript printer. In addition to that, printing the CYMK (cyan, yellow, magenta, black) color separations requires you first to transfer the data to Adobe Separator, a utility program that exists exclusively in the Macintosh environment. Printing half-tone screens is not user-definable, and output scaling features and registration marks are not available.

On the plus side, *Illustrator* is very easy to install: CONFIG.SYS and AUTOEXEC.BAT are automatically modified. *Illustrator* also comes with four helpful manuals: the tutorial is very instructive, es-

pecially for users unfamiliar with curve-based drawing programs; the user guide covers all the program's options in detail; "Symbols, Borders and Letterforms" describes how to use a clip-art library; and the fourth volume describes the *AutoCAD-to-Illustrator* file-conversion process. A handy Quick Reference Card stands by to refresh your memory.

A POWER-HUNGRY PERFORMER

Illustrator is very demanding in terms of hardware. The program will run on 286 machines, but execution is extremely slow, especially when you get into complex graphics and large files. Adobe is aware of this and strongly recommends running *Illustrator* on 386-based PCs.

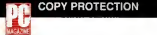
In addition to 640K of conventional RAM, *Illustrator* requires at least 256K of expanded memory. I did my testing on an IBM PC AT (the PC Labs standard test machine) with 640K RAM, 512K of expanded memory, and 3,456K of extended memory. With this hardware setup, I had to wait as long as 3 minutes for a complex file to be refreshed when scrolled onto the



**Adobe Illustrator,
Version 1.0**
Adobe Systems Inc.
1585 Charleston Rd.
P.O. Box 7900
Mountain View, CA
94039
(800) 344-8335
(415) 961-4400

List Price: \$695 (includes a runtime version of Microsoft Windows).
Requires: 640K RAM, 256K expanded memory, DOS 3.0 or later.

In Short: Adobe *Illustrator* is a PostScript-based drawing package that can generate high-quality line illustrations, but Version 1 is a poor indicator of the richness of the program as it exists on the Mac. The PC version has no color support, and the control over type is extremely limited. Except under PostScript, everything prints at 75 dpi—even LaserJet. The program contains a small clip-art library and a couple of text outlines, but at \$695, it does not have many of the tools offered by competing lower-priced programs.



For the past 6 years, *PC Magazine* has diligently reported whether each application software package we reviewed was copy protected or not. Five years ago, 3 years ago, even 2 years ago, copy-protected software was still widely marketed, causing headaches and frustration wherever it went. Now, however, the overwhelming majority of software packages (including one of the most notorious offenders, *Lotus 1-2-3*) are no longer copy protected. Therefore, starting in this issue of *PC Magazine*, we will mention copy protection only when a program has it. If the Fact File's "In Short" section says nothing about copy protection, then the program is free of it.

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screen in preview mode. *Illustrator* also virtually requires a PostScript printer, because printing resolution on non-PostScript laser printers is limited to 75 dots per inch.

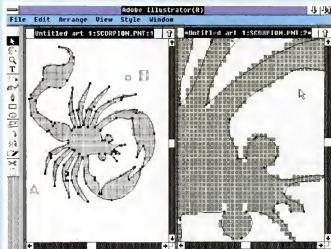
Like most freehand illustration programs, *Illustrator* uses mathematically defined (Bezier) curves as its basic building blocks. Curves, or paths, in *Illustrator* are easy to draw and edit, even by nonexperts. You can create a broad range of variations of an original drawing by changing the curves' control points.

Still, controlling the curvature and tension of lines by manipulating the direction points and length of tangents does not come easy at first. *Illustrator* assumes some familiarity with basic graphics concepts, and the program definitely requires a lot of practice, maybe 20 to 30 hours for mastering advanced techniques.

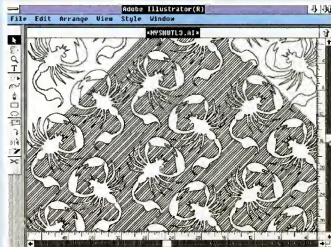
Illustrator's toolbox has 15 tools, including some for selecting, drawing, editing, and viewing. The handiest viewing tool is the zoom tool, which has nine levels of magnification ranging from 6¼ percent to 1,600 percent. Three of the five drawing tools that come with *Illustrator* particularly stand out, and not always for the better: The freehand tool is so jumpy and hard to control that you'll end up staying away from it. The pen tool, however, is excellent for drawing smooth curved and straight lines. Even though this tool does speed up the drawing process, you shouldn't underestimate the amount of time needed for completing an illustration. A lot of extra time is always spent on editing and polishing the final result.

The third noteworthy drawing feature is the auto-trace tool, one of the best I have ever used on either the Mac or the PC. This tool can automatically trace bitmapped images—so-called templates—that have been scanned and saved in .TIF, .PCX, or MacPaint (.PNT) format. The nicest feature about the auto-trace tool is that it can be used for tracing the entire image or just a section of it. The automatic tracings done with *Illustrator* are of superior quality, especially when compared with automatic tracings done by competing programs.

Text manipulation in *Illustrator* is adequate if your typography needs do not go beyond simple business presentations. However, for fine-tuning and detailed type manipulation, *Corel Draw!* and *GEM Artline* are better choices. *Illustrator* allows different typefaces, sizes, leading, and spacing settings to be manipulated in the text dialog box, but only one type style can



Adobe *Illustrator*'s auto-tracing function outlines a template of a scorpion that was originally created as a bitmap file. On the left is the full scorpion; on the right, a zoom into the auto-tracing.



The same scorpion that was outlined with Adobe *Illustrator*'s auto-trace has been copied and moved. This closeup shows the preview screen, including a grid that was rotated 45 degrees and pasted in the background.

PUTTING ILLUSTRATION PACKAGES TO WORK: Hardware Considerations You Should Keep in Mind

by Stephanie Izarek and Gerard Kunkel

The illustration packages we've gathered for this evaluation are quickly becoming popular among professionals in the advertising, graphic arts, and publishing industries. If you're considering upgrading from simpler bitmapped paint programs to these vector-based illustrators, keep in mind that you must be equipped with hardware that's capable of exploiting their power.

The minimum hardware setup required by any drawing package comprises a fast 286-based machine (very fast if your application runs under *Microsoft Windows*) with 2MB of RAM, a 40MB hard disk, an EGA display and, if you want paper output, a laser printer. With anything less, you defeat the purpose of using a vector-based illustration package in the first place. You should be able to round up all the parts for about \$6,400.

However, if you want a top-of-the-line system that will take full advantage of the program's capabilities, you'll need a significantly bigger budget. The ultimate

configuration includes a 386-based machine, a fast-access 80MB hard disk, as much memory as you can afford, a fast 16-bit VGA or Super VGA display, and a thermal-wax-transfer color PostScript printer. You could easily pass the \$25,000 mark for this impressive hardware collection.

The biggest difference between these minimum and ultimate systems is the printer. Right now, most people are using monochrome laser printers like the HP LaserJet II or PostScript devices like the Apple LaserWriter II for illustration, but color is making a big impact

and shouldn't be ignored. Demand for high-quality color output devices is on the rise. Color ink jet printers like the HP PaintJet (\$700) are adequate and affordable output devices, but thermal transfer offers impressive results with rich, accurate color and a high-gloss appearance. An excellent but expensive choice is the Tektronix Phaser CP (also known as the 4693D), retailing for a formidable \$12,995.

What's the best package to use on your system? If you're a beginner and have a Macintosh, you may want to experiment with *MacDraw II*, from Claris. If you're looking for a PC-based option, a good low-end choice is *GEM Draw* from Digital Research. As for high-end packages, our reviews point out strengths and weaknesses. Take a look and decide for yourself which one is right for you. ■



For quality color output, use the Tektronix Phaser CP.

Stephanie Izarek is an editorial assistant at PC Magazine. Gerard Kunkel is PC Magazine's Director of Design and Electronic Publishing.

be defined per box. This means that if you need different type styles in the same line, the line has to be broken up into many items that have to be aligned with each other one at a time.

Illustrator does not distinguish between kerning and tracking (changing the space between two specific characters and the overall space between all characters). Also, *Illustrator* will not allow text to be manipulated as a path; this restricts you from editing the shape, thickness, and other qualities of regular typefaces. In effect, you are limited to changing such attributes as typeface, size, and letter spacing.

Special effects are very limited, too. For example, text cannot be aligned along a curved path. Adobe does, however, furnish a couple of fonts in outline form (as curved paths with regular anchor points) for those who have strong type-design inclinations. These outline fonts are stored in

the clip-art library, a collection that contains over 500 symbols, borders, and letter forms.

The transformation tools in *Adobe Illustrator* include scaling, rotation, reflection, and shearing. All of these tools can be used to transform a path or a group of paths either through freehand mouse control or through the keyboard. In the latter case, you can input precise numerical values in a dialog box after clicking with the mouse button on the item in question while pressing the Alt key. The scaling function allows paths to preserve their original line weight or to scale it along with the path.

EFFICIENT AUTOCAD CONVERSION

The *AutoCAD* .DXF file conversion program bundled with *Illustrator* is very efficient, and it's one of the program's most valuable features. The utility is extremely useful for the electronic creation of techni-

cal documents that contain illustrations originally created with *AutoCAD*. A pull-down menu allows easy access to the .DXF file conversion process.

The space shuttle test illustration was converted from *AutoCAD* into *Illustrator* in less than 2 minutes. It then took *Illustrator* 50 seconds to load and display the converted file.

One minor drawback of the conversion process is that the *Illustrator* files created contain lots of short paths instead of long paths with lots of segments. This results in very few closed contours, which in turn makes filling or painting .DXF-converted files virtually impossible unless major path editing is done first.

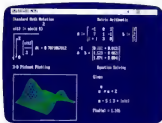
Illustrator is a quality program in many respects. Its major strengths include its overall ease of use, the versatility of its auto-trace tool, the convenience of its *AutoCAD* file conversion utility, and its

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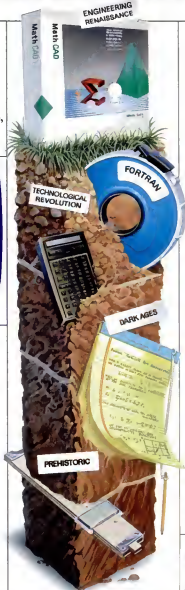


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March 14,
1989 issue.
Best of '88
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PostScript compatibility. However, it falls short on text manipulation, color support, and printing controls. The lack (or poor implementation) of important features in its first PC incarnation—whether or not you compare it with the Macintosh version—leads to one conclusion: just about any other package reviewed here is a better overall buy. Perhaps the upcoming *Presentation Manager* version will put Adobe back in the running.

Corel Draw!

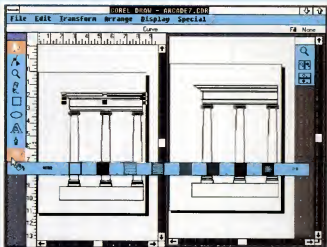
by Maureen Jones

Although it's a new kid on the block, *Corel Draw!* already has an impressive and well-deserved reputation. The program is relatively easy to use, chiefly because the people who put this package together have taken great care to make it as intuitive as possible. Apparently they didn't ask programmers how they thought artists should work; they asked artists how they do work, and they listened to the answers.

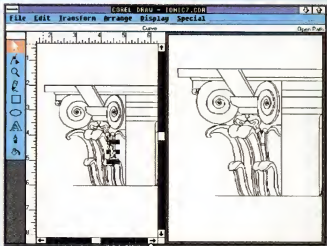
What Corel Systems has produced is a well-organized, uncluttered program with a powerful variety of options—a program that can slug it out toe-to-toe with some of the best Macintosh-based illustration software. For example, the drawing tools are clustered. This means that the same rectangle draw tool can be used to draw a rectangle and a square if you hit the Ctrl key. Once you select either object, you can pull its corners into rounded edges and stretch, skew, or rotate the object around a movable rotation point. With the node-edit tool, the rectangle can be broken into its component parts that can be modified themselves.

Another example: the same pencil tool is used to draw both lines and curves (in conventional drawing, you'd use the same pencil to do both). In both instances, it's how you use the tool that counts. For example, straight lines are produced by clicking and releasing the mouse button, then moving the mouse and clicking again. For curves, you hold the button down while moving the mouse.

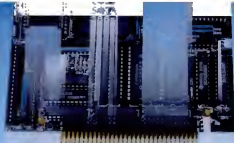
The *Corel Draw!* program is smart, as well. If an imported bitmap (*Corel* imports—and exports—.EPS, .PCX, .TIF, and .WMF files) is currently selected, you choose the pencil tool, which automatically changes into an auto-trace tool. When the bitmap is unselected, the tool reverts to



Though *Corel Draw!* earns its highest marks for its type-handling capabilities, it also has quite a complete set of drawing and shading tools. Here a selection of fills that can be used to shade the columns of the temple is arrayed across the screen.



By using Bezier curves, a complex drawing like this Corinthian capital (a variation on the ionic capitals of the test image) can be made with *Corel Draw!*.



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BYTE, September 1988

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"SOTA 286i turns Dinosaur into Ripsnorting Demon"

BYTE, December 1988

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"...the most flexible turbo board on the market is the SOTA 286i"

PC Magazine PC Advisor, May 16, 1989

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either a line- or curve-drawing tool.

Thanks to well-planned visual cues, you can develop an unusually good rapport with the program. The status line above the work area describes what you've chosen. Is it one object? A collection? Is it an open or closed path? The reasons that these differences are important are given in the manual.

If you want to modify a line with the node-edit tool, the selected segment immediately thickens and a menu pops up beside it with ten potentially appropriate options. Those appearing in black are available; those in gray are not, and checking the status line usually reminds you why. Additionally, an object that cannot be node-edited in its current state immediately changes to a dashed line when the node-edit tool is chosen.

DRAWING UNDER WINDOWS

Corel Draw! is dependent on *Microsoft Windows'* utility programs, including screen and printer drivers. But you'll need to have your own copy of *Windows* because Corel Systems does not supply a runtime version.

Installation is easy, a simple matter of putting in the disk and following instructions. When you first enter the program, the work window comes up with a single, centered page that has a drop shadow added for emphasis. This page's size and shape can be varied, and you can add rulers set to inches, points, or centimeters and fine cross hairs for tracking tool movements. The experienced user can set other preferences, including automatic joins, corner and line thresholds, and line endings.

Corel Draw! is equipped with Bezier curves, and thanks to the superb organization of its handy node-editing pop-up menu, they're easy to use.

The keyboard scaling function is quite useful, allowing you to specify the size of an object in percentages. What's missing, though, is the ability to express the tilt of an ellipse in degrees as well as by listing its major and minor axes.

You'll also have to be prepared to do some work if you turn off the grid to allow greater freedom of movement in positioning various objects. When you go back to working with the grid on, it's likely that the objects you've drawn or repositioned are not going to properly align on it. I can attest to the painstaking and laborious process of dragging the mouse to close the gaps between objects.

PREVIEWING YOUR WORK

The preview function works quite well. The preview image comes in at the same view as the working drawing itself, but you can change the magnification of either in order to place a full page preview beside a working detail. The preview window has its own toolbox, which lets you zoom or unzoom it independently and place preview and work page next to or on top of one another. If you don't want the entire preview to continually update itself, simply initiate another activity in the drawing area, shut off the automatic update, or select only the object in the preview image that you wish to redraw.

When the preview of the test temple drawing came up, the image was filled with solid black areas and some outlines, representing closed and open paths. Because I'd brought back the preview full page, the drawing was relatively small, and it was difficult to distinguish shapes. No problem for Corel. Simply use the tab key to sequentially select objects in the preview image; these objects will then be described in the status line with a fill, if any. (One item on my wish list: the pen's weight and color should be more clearly distinguishable on the status line.)

With the stroke (pen) tool and the fill tool, you can specify line weights, uniform shades, and fountain (gradient) fills. The pen tool produces a choice of weights, ranging from invisible to fairly thick, and a choice of colors or shades. It also lets you

choose a variable-width (calligraphic) style and different end styles. The fill tool gives you access to gray shades, fountain fills, a CMYK process-color model, a Pantone spot-color model, and a really impressive range of PostScript patterns. Power users can access the code for the PostScript patterns.

Corel Draw! makes it easy to estimate the way a fountain fill looks, by locating both the start and end colors in the same dialog box. Although what you see as a fountain fill on the preview screen doesn't look the way PostScript output looks, you do get an adequate representation.

With an IBM AT and a PostScript printer, the resulting paper output is good-looking but long in the works. *Corel Draw!* can use a PostScript printer to make a black-and-white film negative or color separations for the program's PMS spot-color and CMYK color models. The program can be directed to label the separations and to add registration and crop marks.

HP PaintJet output is excellent as long as fountain fills do not spread between colors mixed with black. Corel plans to add the ability to make 35mm slides via *Slide-makers*, also using *Windows* drivers.

WORKING WITH TYPE

Corel Draw! has one of the most extensive and flexible font editing programs anywhere. Corel Systems supplies over 50 proprietary typefaces and styles, 35 of which closely match standard PostScript printer typefaces. As you scroll through the font list in the font dialog box and select various styles, your selection is shown WYSIWYG in a large preview box. You can assign any letter of the alphabet to the preview box, a very handy feature when dealing with logos.

Corel Draw! is a powerful program for designers who work extensively with type. The package goes far beyond custom kerning and leading and gives you the freedom to individually maneuver letters, words, and lines. Letters can be individually flipped, rotated, flopped, and skewed—and automatically realigned. Individual letters can be broken into their line segments for reshaping. Words and lines also can be reshaped, either with the select tool or the node-edit tool. And last but not hardly least, a word or line of type can be fitted to a curved or irregular path.

You can jam over 25 different PostScript fills into an illustration; when I did it, the output printed slowly, but without a whimper.

PC FACT FILE EDITOR'S CHOICE

Corel Draw!
Version 1.02
Corel Systems Corp.
1500 Carling Ave
Ottawa, Ontario
Canada K1Z8P7
(613) 728-8200
List Price: \$495
Requires: 640K RAM,
Microsoft Windows 2.0
or later, DOS 3.0 or
later



In Short: *Corel Draw!* is an outstanding freehand drawing package, as well as a superb resource for 50 precision fonts and over 43 expandable custom PostScript patterns. Its range and ease of use make this a must for the desktop publishing designer who values creative control over type and design and for the artist seeking flexible drawing tools. At \$495, the package may be your least expensive and most valuable illustration resource.

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NO MORE PENCILS: ILLUSTRATION SOFTWARE IS PUT TO THE TEST

PC Labs asked the artists who evaluated these illustration packages to complete two tasks. First, they took a nineteenth-century lithograph of a Greek temple and re-created three columns and the entablature using straight lines, curved lines, freehand lines, partial element symmetry, and pattern shading. A simplified version of the temple lithograph was the artists' goal. Shading and shadow effects were created with fill patterns or fountain fills. Appropriate tools were used to create lines whenever possible—for example, straight lines with the straight-line tool, curved lines with the curve tool. Repetitive images were to be drawn with a copy command where possible.

Next, the artists were asked to create any type of drawing that would highlight the software's unique features. Though use of color was not included in the temple drawing, it was an option for the artists' own creations.

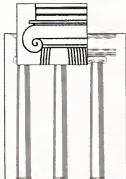
The hardware setup included an IBM PC AT running at 8 MHz, with 640K RAM, a VGA card and monitor, a two-button mouse, and an Apple LaserWriter IINTX printer (a PostScript model). Packages that recommended expanded memory were supplied with it.



ADOBE ILLUSTRATOR

❑ This drawing was created by converting a standard AutoCAD space shuttle file into Adobe Illustrator format, flipping it with the mirror function, and scaling it disproportionately. The scorpions were auto-traced from a bitmap file and then rotated and scaled in different proportions. The shuttle's strokes have a weight of 1 point, while the scorpions are drawn with .25-point strokes.

❑ These columns were made with Adobe Illustrator in about an hour. The column on the left was created first, then grouped and copied. All the horizontal lines were created last.



EXTRAS INCLUDED

The *Corel Draw!* package comes with a typescale (point) rule, a character and typeface reference chart, a process color chart, a quick reference guide, a reference manual, and a video tutorial. The video tutorial serves as an excellent guided tour through some of the more-powerful options, but Corel Systems should also include an interactive tutorial. Going through the motions yourself helps imprint them.

The reference manual is well conceived and illustrated. Each tool is explored thoroughly, beginning with a simple overview of its functions and gradually delving into its more-complex uses. The appendices are illustrated catalogs of custom PostScript fills, character sets, and typefaces, and the index is comprehensive.

There are two types of good illustration packages: those that provide the artist with

efficient tools that can be imaginatively combined, and those whose power lies in releasing the artist from the constraints of its tools. *Corel Draw!* does both. Would I recommend *Corel Draw!*? You can bet your money that I would.

GEM Artline

by Mark Wilson

GEM Artline is the \$495 illustration component of Digital Research's family of desktop publishing software. Developed by a German firm, CCP Software-Entwicklungs, the program operates under *GEM Desktop*, the Digital Research graphical environment manager supplied with the program.

While the *GEM* environment may be unfamiliar to mouse users more accus-

tomed to *Microsoft Windows*, *Artline* files are capable of being ported directly to *Ventura Publisher*, the popular high-end desktop publishing program (and a recent *PC Magazine* Editor's Choice), that also runs under *GEM*. Unlike *Adobe Illustrator* and some other *Windows*-based packages, *Artline* performs at a perfectly acceptable speed on a standard 286 machine.

Installation is in two parts: *GEM Desktop* first and *Artline* second. *Artline* itself is quickly installed via a setup program. A mouse is the standard drawing tool, but *Artline* and *Desktop* also permit use of the keyboard. Usually a cumbersome way to move around, the keyboard is sometimes very useful. For instance, if your machine has only one serial port and both your mouse and output device are serial, you can use the keyboard to output a drawing.

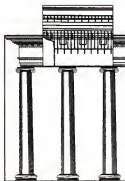
On-screen, *Artline* appears with a white drawing surface; menu boxes with draw-



COREL DRAW!

█ This colorful image demonstrates *Corel Draw*'s Pantone-based spot-color model. It provides a basic palette of ten colors at a time. Identically colored objects were colored using the Copy Style From command, a very handy tool. The word *Punches* has been broken apart into a series of Bezier curves, so that it is no longer text. Each letter is an object and as such can be independently distorted and filled.

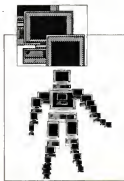
▢ Drawing this elaborate Corinthian capital either would have been impossible or would have taken several hours' work without *Corel Draw*'s Bezier curves. With their help, a drawing like this is relatively simple: It consists of several basic shapes duplicated, moved, and reflected around an axis.



GEM ARTLINE

█ The complex hatching in the entablature of this temple was easy to draw with the help of *GEM Artline*'s move function. A keyboard command is issued to move a single line up, down, left, or right, and as many as 99 copies can be made. Note the uniformity of the entablature's horizontal lines.

▢ This person built of PCs demonstrates a fanciful use of the *GEM Artline* Symbol function. A single computer was first drawn and then converted into a symbol. The scale and aspect ratio of the symbol are controlled by mouse movements, so once the symbol is created and copied, a drawing like this can be completed quickly.



CONTINUES

PC
MAGAZINE

FACT FILE

GEM Artline,
Version 1.0
Digital Research Inc.
70 Garden Ct., Box DRI
Monterey, CA 93942
(800) 443-4200
List Price: \$495
Requires: 512K RAM,
DOS 2.0 or later
In Short: Artline is colorful, competent, and
priced right. Aside from a few missing drawing
tools, this is a well-rounded package; its strength
is in its treatment of text and its accessibility to
Bitstream fonts. Output speed is fast, and the
GEM connection to Ventura Publisher is a big
plus.

ing tools are clustered on the left side of the screen, and pull-down editing menus are arrayed along the top. The program offers seven levels of magnification of the drawing surface, which soon becomes a frequently used function; drawing detailed images requires close scrutiny, but you need to alternate that with zoom-outs for overviews of the picture.

Artline's actual drawing tools are limited to three: curves, rectangles, and ellipses. Curves can be drawn as Bezier splines or as a series of straight line segments. Hence an ordinary straight line is a special case of a curve. The same holds true for the square as a subset of rectangles and the circle as a special case of the ellipse. You can generate a horizontal or vertical line, square, or circle fairly easily using the snap option or the editing tools. The snap function automatically aligns lines or objects to the rectilinear grid, but ultimately my wish

list for *GEM Artline* would include a built-in tool for creating horizontal and vertical lines.

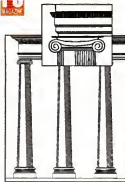
STRONG POINTS

The real potency of illustration software in general, and of *Artline* in particular, lies in its ability to edit and transform an object once it has been drawn on the screen. *Artline* has a powerful collection of tools to manipulate objects, ranging from something as simple as a single straight line to a complex graphic consisting of thousands of subobjects all joined together. The number of editable objects is limited only by the memory in your machine. Scaling, rotation, translation (moving from one point to another), mirroring or flipping, and skewing (shearing an object along one or both axes) are well supported by *Artline*. Selected objects can even be placed in front of or behind other objects.

CIRCLE 418 ON READER SERVICE CARD



NO MORE PENCILS: ILLUSTRATION SOFTWARE IS PUT TO THE TEST



MASS-11 DRAW

❑ The lines that were used to create the columns and shadowing in the *MASS-11 Draw* illustration of the temple had fairly intense aliasing (jaggies). Like *GEM Artline*, *MASS-11 Draw* has copying features that made the complex hatching in the entablature a quick drawing task.

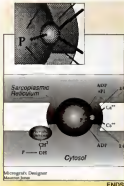
❑ These profiles were created with the *MASS-11 Draw* freehand spline tool. A single curve was drawn (lower left), and seven copies of the curve were made. Each of those curves was then modified by altering its anchor and control points.



MICROGRAFX DESIGNER

❑ With *Micrografx Designer*, small curved lines were joined to form the scrollwork on one side of the capital. The scrollwork was then duplicated, reflected, and repositioned on the other side of the column. Rectangles with rounded and straight corners were used to form the base of the column, and straight rectangles were used at the top. Various flat fills were given to the rectangles to imitate varying depths of shadows.

❑ *Micrografx Designer's* Bezier curves were used to shape the areas around the sphere in this diagram. The radial gradient fills and linear fills make this diagram of a biochemical reaction look three-dimensional. The final drawing was printed on a PostScript printer, using *Micrografx's* own PostScript printer driver. The shapes are distinct and the fills smooth. The text, which is not WYSIWYG on-screen, printed well.



Of particular interest is the "rolling pin" function, which allows a rectilinear object to be distorted along two axes in order to create a pseudo three-dimensional effect in this two-dimensional program. Not only is this sometimes useful, but it is also wonderfully playful. Also noteworthy is *Artline's* move function. Moving and copying an object can be accomplished by entering the horizontal and vertical distances, and the quantity of objects to be replicated.

Artline has 16 colors available at a time (in 100 shades) and seven preset gray scales for each color. Gray scales can also be specified in 1 percent increments, including 0 percent and 100 percent (the default value).

If you are sending your output to a PostScript device, *Artline* has color-separation abilities. Four-color separations (cyan, yellow, magenta, black) are possible (al-

though the feature would be more impressive if you could blend the colors); 16 separate spot-color separations can also be created.

IMPRESSIVE TEXT CAPABILITIES

Text is another of *Artline's* strong points. Five standard fonts are available, and it is possible to generate nine additional typefaces from the included Bitstream *Fontware* installation kit. Additional Bitstream fonts can be purchased separately and used with *Artline*, giving the program vast choice of type. While *Fontware* fonts cost about \$195 per typeface, they are still a good deal. Not only are Bitstream fonts of high quality, but they can also be used in *Ventura Publisher*, *PageMaker*, *Microsoft Word*, and *WordPerfect*.

Text entry is done through a separate window where spacing, leading, and kerning are all user-selectable. When text entry

is finished, the text window closes and the text appears on the drawing. While this procedure does not allow instant visualization, once you're back in the drawing, the text can be selected as a graphic object and treated like a piece of art. Individual letters or the entire text can become objects, thus allowing the full range of graphic transformations to be performed on them.

Eleven finished art samples are provided with *Artline*, as well as ten libraries of symbols; together, these create a modest collection of clip art. Generating your own symbols is a simple matter, and you'll find that using symbols can speed up the drawing process considerably. By clicking and dragging the mouse, the symbol can be compacted to microscopic size or stretched to full screen size.

Artline accepts file input from *Lotus 1-2-3* (.PIC), *PC Paintbrush* (.PCX), and scanners (.TIF). Scanned graphics can be



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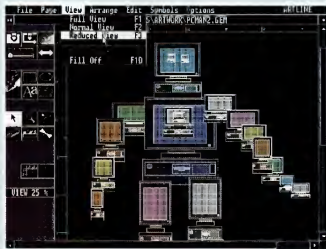
Follow-along tutorials, pull-down menus and context-sensitive help will have managers pouring out memos and reports in less than an hour with no special training or MIS support. What's

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SPC SOFTWARE
PUBLISHING



A sampler of GEM Artline's colors. Sixteen are available, and each color has seven preset gray-scale values in addition to 0 percent and 100 percent. Gray scales are selectable in 1 percent increments.



GEM Artline's Symbol function was used to turn one hand-drawn computer into a symbol that could be copied and reshaped. Then, individual elements were selected and colored using some of the 16 available colors.

traced, but you'll need expanded memory. Output files are in the native .GEM and PostScript (.EPS) formats. The .GEM files are compact—the test illustration of the classical columns was just 31K—and output to a PostScript device is far faster with *Artline* than it is with a Windows-based application.

A wide variety of output devices is supported, although in some cases, additional device drivers must be purchased from Digital Research. For instance, the HPGL plotter device driver will cost \$10, plus \$5 for shipping and handling. All output (besides PostScript output) is handled by

**GEM Artline's full
range of functions
supplies professional
artists with all the
tools they need to get
the job done.**

GEM Desktop (printing can take place at the highest resolution of any printer GEM supports). Fortunately, the output transition between *Artline* and *Desktop* is seamless and painless.

Documentation comes in three parts: the *Desktop* guide, an *Artline* reference, and an *Artline* user guide. In the future, it would be helpful if DRI would consolidate the two slim *Artline* guides into a single volume, thereby eliminating the need to switch between them continually. The documentation, while seeming to be not very detailed at first glance, ultimately answers almost all your perplexing questions.

Artline is a strong package, despite a few missing features in its drawing toolbox, and it's a relative bargain in this category of software. The program's full range of functions supplies professional artists with all the tools they need to get the job done. On top of that, the user interface is cordial and responsive. *Artline* illustration software has broad artistic applicability. In disciplines like graphic design, the ease with which it lets artists manipulate text and graphics will surely help to transform their working methods permanently.

Spreadsheet Rivalry Heats Up

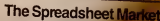
...products are not enough if software is not displayed in computer stores.

‘Things getting

'Things are getting down and dirty,' a computer analyst observes.

Dealers who have seen what will be
...w no mo

Dealers who have seen what will be
...w no mo



OTHER 6.1%

RACE C VS. PO

not when it is established.

We Interrupt T War For This Im

To all those unlucky enough to be stuck smack in the middle of the current spreadsheet confusion, take heart.

There is, at last, a viable alternative to war: revolution.

One that delivers even more performance than you have (ahem) been waiting for, but without demanding expensive new hardware or extensive retraining. And without abruptly cutting you off from any user in your company, even those on mainframes.

The name of the spreadsheet is SuperCalc®5.

And what it can do for you is, frankly, quite revolutionary.

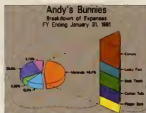
Let's begin at the end. Stand-alone quality graphic capabilities have been built in.

Offering hundreds of presentation treatments from word charts to three-dimensional bar, pie, scatter, and polar graphs.

And with SuperCalc5, you select fonts, lines, boxes, grids and shading. All of which can be used to produce the highest quality customized reports.

Plus, SuperCalc5 actually makes productivity easier. An integrated Undo feature simply reverses unwanted commands. And a truly comprehensive system of debugging highlights costly errors and analyzes macro logic.

Perhaps even more impressive



Present a state-of-the-art picture of your work

Andy's Hardware Mid-Year Consolidation					
	North	South	East	West	Total
Cost	\$200,000	\$175,000	\$200,000	\$175,000	\$750,000
Depreciated	(120,000)	(175,000)	(170,000)	(170,000)	(635,000)
	\$80,000	\$0	\$30,000	\$5,000	\$115,000
Quarter 1 Results					
	North	South	East	West	Total
Cost	\$125,000	\$125,000	\$100,000	\$100,000	\$450,000
Depreciated	(60,000)	(60,000)	(50,000)	(50,000)	(220,000)
	\$65,000	\$65,000	\$50,000	\$50,000	\$230,000
Andy's Hardware Year-End Results					
	North	South	East	West	Total
Cost	\$200,000	\$175,000	\$200,000	\$175,000	\$750,000
Depreciated	(120,000)	(175,000)	(170,000)	(170,000)	(635,000)
	\$80,000	\$0	\$30,000	\$5,000	\$115,000

Let me ask about everything in sight.



Catch bugs before they

**POWER
TION**

The field had been ranked and the odds
for a computer spreadsheet software, a

**New program
... to fend off
spreadsheet war**

GE, Mass.—Lo-
... to fight the
... with sweep-
... reseller pro-

• A restructuring
MIF plan. The
... training com-
... enhanc-

**Spreadsheet 1A
Ready to Pounce**

January 28, 1989

Analysts said that in 1989
... who will battle

**... Gains:
... on Rival**
... creating a spreadsheet, b
... imitation of

The Spreadsheet portant Update.

to be precise. Linking either in memory
or on disk, either pages of the same spread-

sheet or inde-
pendent, either
SuperCalc5's files
or Lotus® 1-2-3's.

Which brings
us to the "L"
word. SuperCalc5
not only reads
and writes Lotus®
1-2-3 files, it
totally coexists
with Lotus.

and compatible computers but also
takes full advantage of 286 and 386 machines
when you decide to make that transition.

And if all that isn't enough to make you
run out today and join the revolution, there's
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you're using. Call 1-800-
531-5236. In Canada
call 1-800-663-6904.

Which finally brings us
to our admittedly biased
outlook for the much touted spreadsheet war

With SuperCalc5, peace is at hand.

Andy's Business

Business Development
FY Ending December 31, 1988

Category	Item	Value	Value
Sales	Net Sales	\$1,234,567	\$1,234,567
	Cost of Goods Sold	(345,678)	(345,678)
	Gross Profit	\$888,889	\$888,889
	Net Income	\$123,456	\$123,456
Operating Expenses	Salaries and Wages	\$234,567	\$234,567
	Advertising	\$45,678	\$45,678
	Travel	\$12,345	\$12,345
	Utilities	\$8,901	\$8,901
Other Expenses	Depreciation	\$34,567	\$34,567
	Interest	\$23,456	\$23,456
	Income Taxes	\$12,345	\$12,345
	Other	\$5,678	\$5,678
Financial Data	Operating Assets	\$567,890	\$567,890
	Operating Liabilities	\$123,456	\$123,456
	Operating Equity	\$444,434	\$444,434
	Operating Income	\$123,456	\$123,456

Produce annual report quality output everyday

Letting you easily move 1-2-3 macros into
SuperCalc5 and back again. Even toggling
between menus is a snap for SuperCalc5.

But not for Excel!

Which now brings us to the "E" word.
Unlike Excel, SuperCalc5 runs on all IBM®

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**COMPUTER
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Software superior by design.

MASS-11 Draw

by Mark Wilson

MASS-11 Draw is a sophisticated product designed for the technical illustrator. Developed by Microsystems Engineering Corp. (MEC), a company that writes office-automation software for Digital minicomputers, *MASS-11 Draw* (MASS stands for Microsystems Administrative Support System) runs on both PCs and VAX workstations.

This is a no-nonsense program that's extremely proficient in most drawing techniques, especially those applicable to the technical end of the market. It has only one serious limitation that might affect some potential users: it doesn't produce color output at all. But given the fact that a majority of *MASS-11 Draw*'s audience will be sending their output to monochrome printers anyway, the product's many virtues more than compensate for this one deficiency.

MASS-11 Draw comes with a comprehensive 300-page loose-leaf manual, and MEC suits the media to your requirements; our evaluation package came with eight 360K floppies. Installation is straightforward, although starting up the program assumes a degree of computer literacy. The inexperienced user may object to the fact that you must either create a batch file with a SET command or issue a SET command specifying the various setup parameters for the program. The advantage of this approach is that you can easily alter one setup parameter without having to rerun an entire setup program.

GRAPHICS FILE FORMATS: Know What You Want, Get What You Need

by Catherine D. Miller

Most drawings produced with the illustration packages evaluated here are either exported to another package or sent to a hard-copy output device. Since graphics file formats abound, it's essential to consider the final use of your creations and determine whether the illustration package you choose can produce a compatible graphics file. Knowing a bit about graphics file formats simplifies your decisions.

The two basic types of graphics file formats, raster (bitmapped) and vector (object-based), are used for different types of graphics. Although images stored in raster format can be converted indirectly to vector format through auto-tracing, the reverse process isn't possible.

Raster images are described as a series of pixels. They are appropriate for scanned gray-scale images (.TIF), captured images (.TGA), and paint-program images (.PCX).

Vector images are stored as a list of drawing instructions describing individual objects. (Except for the .EPS format; in this case the image is described in the procedural PostScript language, which is more complex and powerful than a simple list of instructions.) Vector formats excel with high-end graphics, since images can be resized without loss of resolution, lines are smoother, and objects are treated individually. Illustration, CADD, and

presentation graphics packages produce vector graphics files.

.CGM (Computer Graphics Metafile): Although .CGM was created by several standards committees with the intention of serving as a standard device- and machine-independent graphics file format, several incomplete implementations of the current .CGM standard are in common usage. A .CGM file is easier to revise than an .EPS file, and it is portable between systems. The format is supported by *PageMaker*, *Ventura Publisher*, and many business graphics programs.

.DRW (Micrografix DRAW): Micrografix created a *Microsoft Windows* .PIC file format in which to store its images. A newer version of this file format is .DRW. This format is supported by all Micrografix applications and can be imported into *Ventura Publisher* and *Legend*. Not being limited to 64K gives it an advantage over .WMF.

.DXF (Data Exchange File): Autodesk created .DXF as an external drawing exchange format to encourage third-party development. Since a .DXF file is so large, a smaller, binary version of this format, .DXB, is now available. The .DXF format is supported by virtually every PC-based CADD package.

.EPS (Encapsulated PostScript): This file format was created to carry images from drawing programs to desktop publishing programs. Encapsulated PostScript is a combination of bit-

Once installed, the *MASS-11 Draw* screen comes up sporting a black background and green text. The drawing tools menu is arrayed along the left margin while the top margin of the screen contains the editing and function menus. Located in the upper-left-hand corner at the junction of these two menus is a small rectangle that corresponds to the larger drawing surface. The active drawing area is depicted within this rectangle—clicking and then releasing the mouse button on a section of the small rectangle automatically and instantly moves you to the corresponding clicked-

on section of the drawing surface. Another attractive feature is that two pages are available for drawing, which makes copying, cutting, and pasting from one page to another a simple procedure.

MASS-11 Draw has the standard drawing functions: straight and orthogonal lines, polylines (a set of joined straight line segments), circles, ellipses, squares, and rectangles. The additional offerings of an equilateral triangle, a rectangle with rounded corners (the radii can be selected), and an arc function are convenient and useful for charting and graphing.



FACT FILE



MASS-11 Draw, Version 5.2
Microsystems Engineering Corp.
2400 W. Hasselt Rd., #400
Hoffman Estates, IL 60195
(312) 882-0111
List Price: \$695; site licensing available.
Requires: 512K RAM, DOS 2.0 or later.
In Short: If you don't need color and an extensive selection of type fonts, then *MASS-11 Draw* will satisfy all your freehand illustration needs. Easy to use, it is particularly adept at technical illustrations and spline curves, and it offers a rich set of editing functions.

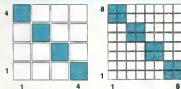
CIRCLE 418 ON READER SERVICE CARD



THE ART OF MAINTAINING IMAGE INTEGRITY

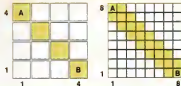
RASTER

A raster (bit-mapped) image stays the same size and continues to appear jagged when screen resolution increases.



VECTOR

A vector image increases in quality when screen resolution increases because it is a point-to-point construction in which the software draws a line of unchanged thickness from point A to point B.



When you increase the resolution (measured in pixels per inch, or ppi) of the screen or output device by a factor of 4, the resolution of a vector image is also increased, and its quality is increased.

The resolution of the same image in raster format doesn't change when the device's resolution does, so the image maintains its coarse edges.

mapped and vector-based graphics information. The vector portion is described in the powerful PostScript language, while the bitmapped picture, which appears on your screen, is described in the TIFF format. A PostScript-compatible output device interprets the vector information. This format is especially adept at rendering complex drawings and is supported by PageMaker, Ventura Publisher, IBM

Interleaf Publisher, and many presentation graphics programs.

GEM (Graphics Environment Manager): Files created in the graphical GEM Desktop environment are usually saved in Digital Research's own graphics file format. Such files are easily imported into other applications that run under the GEM environment, such as Ventura Publisher and several other GEM applications developed by Digital

Research (including GEM Artline).

HPGL (Hewlett-Packard Graphics Language): One of the oldest graphics file formats, Hewlett-Packard developed HPGL for two-dimensional pen plotting. Although not very sophisticated, this format is entrenched in the PC graphics market; it's supported by most DTP, CADD, and business graphics programs and output devices.

IGES (Initial Graphics Exchange Specification): IGES is a nonproprietary graphics file format created by the CADD industry. It is often used by firms that need to transfer CADD information among mainframe, mini, and PC platforms. Although this promising standard suffers from uneven implementation, it is currently supported by AutoCAD, Cadkey, VersaCAD, and many other CADD programs.

PIC (Lotus Picture File): Lotus developed this relatively simple file format to store descriptions of graphs created in Lotus 1-2-3. Although it isn't suitable for high-end graphics, this format is widely supported as input in both DTP programs and presentation graphics programs.

WMF (Windows Metafile Format): This format was developed to exchange graphics information between Microsoft Windows applications; it cannot be used in non-Windows applications. The biggest drawback of the .WMF format is the 64K file size limitation imposed by the Windows clipboard.

Catherine D. Miller is a staff writer at PC Magazine.

POWERFUL CURVES AHEAD

MASS-11 Draw is endowed with a particularly powerful set of curve functions. Curves can be approximated in two ways: drawn splines or freehand splines. (The notion of splines comes from naval architecture: Very thin wooden strips called battens are positioned with leaden spline weights. Thus, complex curves can be drawn along the battens.) A spline curve consists of two anchor points at the ends of the curve, plus two control or handle points that bend the curve. **MASS-11 Draw** uses a mathematical description of the

curve (the Bezier function).

Drawing the spline curves is completely nonintuitive. You must first set the anchor point, then the control points. But, like learning to ride a bicycle, after a few initial disasters it begins to seem like a perfectly natural way to create a curve.

However, **MASS-11 Draw** features a somewhat easier method of creating a spline curve: The freehand curve tool allows you to move the mouse or stylus in a continuous sweep. When the curve is finished, the program adds anchor and control points, thereby allowing you to edit the

curve by moving the points until you are satisfied with the shape. Editing either freehand or drawn splines can be time-consuming, but the precision with which you can tailor the curve is immense.

FULL-FEATURED EDITING

Once you create a curve, line, or other object, you'll be able to explore **MASS-11 Draw's** editing functions. This is where the real power of the program resides. Everything is considered to be made up of objects. In its elemental form, an object consists of a single line; at its most complex,



ILLUSTRATION SOFTWARE: SUMMARY OF FEATURES

(Products listed in ascending price order)

DRAWING TOOLS

	Corel Draw \$495	GEM Artline \$495	Adobe Illustrator \$895	MASS-11 Draw \$695	Micrografx Designer \$695
Straight lines	●	●	●	●	●
Orthogonal lines	●	●	●	●	●
Selectable line caps (endings)	●	●	●	●	●
Invisible lines	●	○	○	●	●
Arrowheads	●	●	●	●	●
Rectangles	●	○	●	●	●
Round corners for rectangular shapes	●	○	○	●	●
User-controllable corner roundness	●	○	●	●	●
Freehand curves	●	○	●	●	●
Automatic close of curve paths	●	●	●	●	●
Fills	●	○	○	○	●
User can edit and store new patterns	●	○	○	●	●
TEXT					
Text can be edited on-screen	●	●	○	●	●
Text can be wrapped around a curved path	●	●	○	○	●
Text can be treated as a graphic element	●	●	●	●	○
Uses Bitstream Fontware fonts	●	●	○	○	●
Uses Adobe fonts	●	●	●	●	○
EDITING					
Multiple copies of active elements can be made	●	●	○	●	●
Curves can be reshaped with the control points	●	●	●	●	●
Curves can be scaled with the handles	●	●	●	●	●
Tangent lines and direction points are visible when curve is active	●	●	●	●	●
Points in existing curve can be inserted and deleted	●	●	●	●	●
Automatic curve smoothing is available	●	●	●	●	●
Polygonal lines can be made into splines	●	●	○	●	●
Attributes can be copied from object to object	●	●	○	○	●
DISPLAY					
Zoom feature	●	●	●	●	●
User-adjustable zoom	●	○	○	○	●
Dimensioning display	●	○	○	●	●
Status box with alphanumeric information	●	○	○	●	●
Measuring rulers	●	●	●	●	●
Simultaneous access to multiple documents	●	○	●	●	●
Color models available	CYMK, monochrome, Pantone	CYMK, monochrome, RGB	CYMK	Monochrome	CYMK, CMYK, HSB, monochrome, Pantone
Program stores palettes	○	○	○	○	●
MEASUREMENTS					
Dimensions expressed in user-defined units	●	●	○	●	●
User-definable grid	●	●	○	●	●
User-definable page size	●	●	○	●	●
List of document parts can be displayed and printed	●	○	○	●	●
Elements can be dragged and placed outside page	●	●	○	●	○
Document can be developed in layers	○	●	○	●	●
Maximum number of pages allowed in a document	1	1	9	2	54
TRANSFORMING					
Select and move	●	●	●	●	●
Rotate	●	●	●	●	●
Skew or shear	●	●	●	●	○
Flip or mirror	●	●	●	●	○

—Editor's Choice ● —Yes ○ —No

GRAPHICS ILLUSTRATION SOFTWARE

	 Corel Draw! \$495	GEM Artline \$495	Adobe Illustrator \$695	MASS-11 Draw \$695	 Micrografix Designer \$695
TRANSFORMING					
Clip or cut	●	●	●	●	○
Move to back or front	●	●	●	●	●
Snap to guides (or grid)	●	●	○	●	●
Object-to-polygon conversion	●	●	○	●	○
Automatic isometric projection	○	○	○	○	○
Shape clipping (using shape as cookie cutter)	●	○	○	○	○
Shape Interpolation	○	○	○	○	○
3-D capabilities	○	○	○	○	○
Auto-tracing	●	●	●	●	●
Elements can be grouped and ungrouped	●	●	●	●	●
Elements can be aligned in relation to the page	○	○	○	●	●
Elements can be aligned in relation to each other	●	●	○	●	●
Pivot point can be specified	●	●	●	●	●
Bitmaps can be incorporated in the final image	●	●	○	○	●
PRINTING					
User-defined page margins	●	●	○	●	●
Crop marks or center marks	●	●	○	○	●
Registration marks	●	●	○	○	●
Process-color separations	●	●	○	○	●
Spot-color separations	●	●	○	○	●
Color PostScript printing supported	●	●	●	○	●
INPUT GRAPHICS FILE FORMATS					
.CGM (Computer Graphics Metafile)	●	○	○	●	●
.DRW (Micrografix Draw)	○	○	○	●	●
.DXF (AutoCAD)	○	○	○	○	○
.EPS (Encapsulated PostScript)	●	○	●	○	○
.GEM (GEM Draw or Graph)	○	●	○	○	○
HPGL (Hewlett-Packard Graphics Language)	○	○	○	●	○
PC Paint	○	●	●	○	○
.PIC (Lotus)	○	●	●	●	○
.PICT (Macintosh)	○	○	○	●	○
.SLD (AutoCAD)	○	○	○	○	○
.TIF (Tagged Image file format)	●	●	●	●	●
.WMF (Windows Metafile)	○	○	○	○	○
Generic bitmap format (including scanned images)	●	●	○	○	●
File-conversion utility program	●	○	●	●	○
OUTPUT GRAPHICS FILE FORMATS					
.CGM (Computer Graphics Metafile)	○	●	○	○	●
.DRW (Micrografix Draw)	○	○	○	●	○
.EPS (Encapsulated PostScript)	●	●	●	●	●
HPGL (Hewlett-Packard Graphics Language)	●	○	○	●	○
.PIC (Lotus)	○	○	○	○	○
.PICT (Macintosh)	○	○	○	●	○
.TIF (Tagged Image file format)	●	○	○	○	○
.WMF (Windows Metafile)	●	○	○	○	●
DOCUMENTATION					
Tutorial manual	○	●	●	●	●
Interactive tutorial	○	●	○	○	○
Tutorial sample files	●	○	○	●	●
Reference manual	●	●	○	●	●
Glossary	○	○	●	●	●
Troubleshooting guide	○	●	●	○	○

MASS-11 Draw

an object consists of all the lines and patterns that constitute the drawing. Objects can be combined, separated, or duplicated, and the software performs all the standard 2-D transformations (translation, scaling, and rotation) on them.

Microsystems Engineering has given *MASS-11 Draw* an excellent collection of tools with which to perform these editing tasks. Unselected objects in the drawing are shown with green lines on a black background. Unlike most other freehand illustration packages, *MASS-11 Draw* does not surround selected objects—the active elements—with a bounding box and square “handles” at the corners. Instead, selected elements are shown in yellow or orange; this helps reduce the visual complexity of an image with many elements. Auto-scrolling—the ability to drag a selected object off the screen—is another very welcome touch.

The text abilities of *MASS-11 Draw* are adequate, though not nearly as amazing as those of *Corel Draw!* or *GEM Artline*. Although font selection is modest (a Roman and a sans serif Modern are all that are available) point sizes range from 1 to 144. The aspect ratio and spacing can be easily altered. Text editing can be done directly on the drawing, and word wrapping is standard. Of special interest to technical users is the set of scientific ISO characters as well as subscripts and superscripts provided with the package. Unfortunately, while the available typefaces are output to laser and PostScript printers as very hi-res Adobe-compatible fonts, they are displayed on the screen as highly simplified vectors, making it impossible for you to get a true visual impression of your work.

The measuring tools available with the package are noteworthy. A ruler and grid toggle are standard, and a nifty feature is a real-time coordinate ruler that shows the *x* and *y* values of the cursor. When editing an object, the real-time ruler also reads out angular rotation, changes in scale value, and the like. This feature is obviously useful to the technical illustrator. *MASS-11 Draw* also allows multiple objects to be aligned along margins, as well as to be evenly distributed. Both operations are particularly useful for creating charts and graphs.

While color is not supported, grayscale fills are available in 1 percent increments. Choices of fill patterns, line styles, and line endings are available; also, line widths can be varied from 0.001 to 0.1 inch. In its most recent update, MEC of-



The *MASS-11 Draw* screen is black with green lines, and the upper-left corner of the screen contains a small representation of the drawing surface. Drawing tools are along the left and editing menus are along the top.



With *MASS-11 Draw*, lines that are currently selected for manipulation in a drawing show up in yellow/orange. Here, the base of the first column is being worked on.

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—Andrew Seybold, *Outlook on Professional Computing*, September 1988

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Performance Comparisons using PC Labs Benchmark Series Release 4:

	NOF	80286 Instruction M/s	Floating Point Calculation	Conventional Memory
ZEOS 286/12 Desktop	2.81	4.78	18.84	0.72
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IBM PS/2 Model 50	3.35	7.20	28.34	1.05

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IBM PS/2 Model 70-E61	2.09	4.11	16.14	0.77
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fers screen preview of line widths. This is important because line width is crucial to the visual quality of the drawing, especially in technical illustrations. It would be advantageous if the black screen and green line colors could be changed within the preview mode to a white background with black lines to better simulate a laser printer's output.

Printing the finished image is a simple matter. The print menu allows many parameters: the image can be cropped in any way, as well as scaled, and any section can be chosen with the mouse for a fast Quick-Print function. *MASS-11 Draw* works with most dot matrix, PostScript, and laser printers; HPGL and compatible pen plotters are also supported. For high-resolution output, Linotype 100/300 PostScript phototypesetting machines can be used as well.

MASS-11 Draw contains an extensive symbol library. Most of these symbols are designed for engineering, but it is possible to create a custom symbol library. You'll find using the symbols effortless: simply drag a symbol from the menu and release the left mouse button for it to be placed right on the drawing.

MASS-11 Draw is good at importing image files: Lotus .PIC, HPGL, and Macintosh PICT files are supported. An auto-tracing utility, *MASS-11 Tracer*, converts TIFF scanner files into *MASS-11 Draw* (.DRW) files that are written in an ASCII-based file format described extensively in the documentation. These *MASS-11 Draw* files have both a positive and negative aspect: because they are written in public ASCII format, the data they contain can be easily examined, edited, and manipulated, the files, however, are quite large. A medium-size drawing—such as the classical architecture test illustration—takes up a big 156K.

If color is important in your work, then this package isn't for you (although MEC is working on a color version). Similarly, if you need access to a large collection of typefaces, then *MASS-11 Draw* isn't the right choice. While the program benefits by running at a decent speed on a standard AT, its real strengths are in features like superscripts, measuring tools, and engineering symbols that make it particularly appealing to technical illustrators. If these qualities are what you are looking for, you may want to invest your money in *MASS-11 Draw*.

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Micrografx Designer

by Maureen Jones

Micrografx Designer is an extraordinarily powerful package, not only for its drawing tools but also for its efficient utility programs. Any designer or illustrator whose focus is on technical or mechanical illustration will find *Micrografx Designer* a valuable resource.

Designer 2.0 (a big improvement over Version 1, which won a *PC Magazine* Award for Technical Excellence last fall) imports and exports a wide variety of files, including *AutoCAD* .DXF, .TIF, .WMF, .PIC, .CGM, and .DRW formats. It also exports Encapsulated PostScript (.EPS) formats. It boasts technical, CADD-like must-haves, including layers (a whopping 64) and the ability to customize the toolbox by setting up a combination of the most frequently used tools. In addition, you can define your own color palettes.

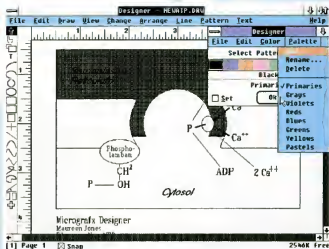
You'll find the addition of on-line, context-sensitive help to be very useful, especially considering the confusing user interface. For instance, although there are specific tools for every drawing function, most of them are capable of performing each other's jobs. From the artist's viewpoint, it's more efficient to use the same tool to create, say, a square and a rectangle, in much the same way *Corel Draw!* does.

Micrografx Designer can be run either under an included runtime version of *Microsoft Windows* or as a standard *Windows* application. No matter which version you use, you'll want additional memory so that you can take advantage of *Designer's* more-elaborate features. If you try to work in the required 640K RAM, you'll soon need more.

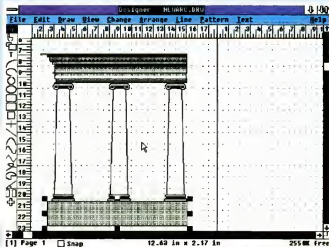
MORE NEW AND IMPROVED

The product now includes Bezier curves, making freer drawing styles more practical than they were with earlier versions. The Bezier curves are easy to use and have a wonderful characteristic: the handles used to direct and contour the curves are shaped like four-leaf clovers, not squares.

When both the nodes and the handles are the same shape—as they are in most illustration packages—it's easy to grab the wrong box when you're zooming up and down. Also, small square handles can be difficult to find when they're superimposed on a line. The clovers are easy to



Micrografx Designer has the most sophisticated integration of color into its drawing tools. Here, a chemical diagram is being created, and two color menus have been invoked on the right. Pantone colors are among the available selections.



Micrografx Designer, which actually has some CADD functionality, has all the tools necessary to do a good job on an architectural-style drawing like the one we used as a test image.



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spot—even when they straddle a line.

There's also more power in the text menu than earlier versions offered. Multiple-line text can be separated into single lines, and conversely, single-line text can be joined into paragraphs. Imported bitmaps can be cropped and automatically traced, and images can be arrayed horizontally and vertically, rotated and scaled, and assigned graduated color.

The package benefits from having its own PostScript driver. Illustrations print twice as fast with the Micrografx driver than they did with earlier versions of the program, which used the Windows driver. Even if you don't buy *Designer*, you can buy the PostScript driver directly from Micrografx for \$195.

Besides the superior black-and-white laser printer output, there are versatile provisions for spot-color and process-color separations. PostScript printouts are sharp and clear, with consistently subtle gradations from dark to light in the fills. *Designer* printouts can include page labels, crop and registration marks, and bleeds. You can select noncontiguous pages for printing in multiples. A new Matrix film recorder driver lets you create slide output as well.

DRAWING TOOLS AND MOUSE SUPPORT

In working with *Micrografx*'s wide range of tools, I found the freehand tool to be awkward to use and control. On the other hand, object snap is versatile: It overrides snap to ruler and lets you snap to endpoints, center, midpoints, vertex (the default), or any combination. You can snap objects on all levels, one level, or none to have snap points only in uncombined symbols.

The lack of a scaling dialog box is a problem, as scaling is an important function in mechanical drawing. You'll have to scale the old-fashioned way—by dragging a handle on the selection box. Luckily, it works efficiently. You resize proportionately by dragging a corner handle. Pressing the Shift key will change to nonproportional sizing, and the control key will get you square proportions. Even handier is being able to use the second mouse button to move the symbol around while resizing it. This is a nice feature to have when you're trying to get a good fit.

The repeat tool is hidden deep within the arrange menu, and there's no clue as to its existence in the index! It turns out that linear array is a very powerful tool that will let you make up to 100 duplicates of an object horizontally, vertically, or diagonally. You set the number and intervening units in the dialog box. Handily enough, if you first duplicate and move the copy, the dialog box will then describe both the coordinates and dimensions of your move. You then simply enter how many more copies you want.

There is no separate preview function in *Micrografx Designer*. Your drawing and fills occupy the same image. You can speed up redrawing by turning off gradient fills (these can be linear and can have an adjustable angle, or radial, with a variable center point), but awkwardly enough, you can't shut off the fills' redrawing. Not only is it time-consuming to watch fills rebuild, but there are many instances when it would be appropriate to view line work only. In detailed work requiring fine-tuning of points, fills not only cover up underlying areas but also distract you while the objects redraw.

To get an idea of the backgrounds for labels in the biochemical diagram I drew, I filled the objects. Screen resolution, of course, is not at all close to that of PostScript output, but I had enough visual information to determine how the back-

ground might set off the type. Wandering through the color menus cued me to gradient fills, and I found access to colors and fills through the line, text, pattern, view, and change menus.

Selecting the color gray produces the percentages for your PostScript fill; you click on the one you want. However, when



EDITOR'S CHOICE

- Corel Draw!
- Micrografx Designer

Corel Draw! and *Micrografx Designer* are very different programs, but both merit Editor's Choice recognition. Both run under *Microsoft Windows* (as does *Adobe Illustrator*), and until Presentation Manager applications arrive, the most-capable PC-based graphics tools will continue to be found in the *Windows* environment.

In the case of *Corel Draw!*, \$495 gets you outstanding font control, good color capabilities, and just about as many drawing tools as other packages that cost \$200 more offer. You should buy *Corel Draw!* especially for its type-handling capabilities.

Version 2.0 of *Micrografx Designer* amply improves on Version 1.3, which won *PC Magazine's* Award for Technical Excellence last year. In fact, it's also an editor's choice in the literal sense, since it's used by the graphics team here to create the illustrations you see in *PC Magazine*. Though the user interface isn't as logically arranged as that of *Corel Draw!*, the program has wide capability in all types of drawing, including CADD-like applications. Version 2.0 also expands *Designer's* color capabilities and adds context-sensitive help.

Finally, the obvious question of whether any one of the five programs we looked at is a real competitor with Macintosh-based illustration programs comes up. The answer, in the case of the first PC version of *Adobe Illustrator*, is a resounding no. *Micrografx Designer* and *Corel Draw!* don't quite match the Macintosh challenge (as represented by *FreeHand* and *Illustrator 88*) either, but they're closer than ever.

PC FACT FILE EDITOR'S CHOICE

Micrografx Designer,
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In Short: Windows-based *Designer* stands with *Corel Draw!* as the best of the PC-based design illustration tools. Version 2 adds more color and freehand drawing tools (auto-trace, Bezier curves) to an already superb set of mechanical and technical illustration capabilities. Included Micrografx drivers are more efficient than those found in *Windows* (PostScript, LaserJet). *Designer* is the only package among the five that includes auto-dimensioning. Twenty-four fully compatible, separate clip-art libraries with over 12,000 high-quality images are also available. Drawbacks: It's hard to learn, despite on-line help in this version, menu choices are somewhat confusing, and text handling is meager compared with *Corel Draw!*'s.



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you're filling an object (or placing a pattern), you should be able to pick up both ends of the range more conveniently than *Designer* allows: The color dialog box for the background color is under the change menu and the object color box falls under the pattern menu. The odd part is that both box colors seem almost identical.

Designer's type-handling features are not rich. They lend themselves more to labeling than to design. The program does, however, have some powerful text-editing features. You can enter text either directly on the graphics screen or in the text editor. Small point sizes are automatically entered in the text editor.

You can merge text from other programs like word processors—a feature that

one of the handiest I've seen; it gives a quick synopsis on using the *Windows* environment and offers technical notes on using extended and expanded memory.

The tutorial new to Version 2.0 of *Designer* has excellent sections on using Bezier curves and auto-tracing bitmaps. It advises you on how to set up the action and then leads you through step by step, explaining why you're doing it.

The user manual is the new user's most important tool, and I found the current version inadequate. The index was skimpy; try looking up how to zoom or magnify your image, for example. Also, I couldn't find references for several tools, including linear and radial gradient fills. The organization was baffling; for example, the first part of the Editing Drawings section instructs the power user on setting up symbol identifiers. What about learning how to adjust a simple outline first?

Designer evolved out of another product, *Micrografx Draw Plus*, which is still available at a price of \$395. But *Designer* is by far the more sophisticated of the two, and even though there's a price difference of \$300, you should definitely bypass *Draw Plus* and go straight to *Designer* if you want the fullest illustration functionality.

Once I got a sense of *Designer's* organization, it took—quite literally—less than an hour to put together the complex biochemical diagram. *Micrografx Designer* is without a doubt an important illustration tool; it needs only to be friendlier and better organized. As programs like *Corel Draw!* prove, power and accessibility are not mutually exclusive. ■

Maureen Jones teaches computer graphics illustration at Pratt Institute and the School of Visual Arts in New York City. She specializes in medical and technical illustration. Isaac Victor Kerlow is an artist and designer who has used computer graphics since 1980. He is chairman of the computer graphics department at Pratt Institute and coauthor of Computer Graphics for Designers and Artists, published by Van Nostrand Reinhold. Mark Wilson is a West Cornwall, Connecticut-based artist specializing in computer drawings and paintings. His book, Drawing with Computers, was published by Putnam, and in 1983 he was awarded a National Endowment for the Arts fellowship for his computer drawings.

Micrografx has its own 24-volume library containing more than 12,000 clip-art images.

could come in handy for setting up tables and charts. Each word can be entered separately, and each line can be made into a separate text symbol by using the Shift-Enter key combination. Text can be edited in the drawing area or in the text editor with familiar word-processing keyboard interaction (Esc, Home and End keys, and the rest behave as expected). Unless you specify otherwise, the text background is transparent. Leading can also be specified.

Although you have a choice of fonts, the text is usually not WYSIWYG. Rather, it is a generic visual shorthand, good for evaluating size and position. It is easy to position and more than adequate for most labeling chores.

Micrografx has its own 24-volume library of over 12,000 clip-art images available at extra cost. Besides a hefty supply of program, sample, clip art, and utility disks for both 5¼- and 3½-inch disk drives, the package includes a separate installation guide, a written tutorial, a user manual, and a user guide to a utility program that converts *AutoCAD* files to *Designer* files, and vice versa (*Adobe Illustrator* includes a similar utility). The installation guide is



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"The announcement of IBM's OS/2™ operating system along with the powerful new PS/2® and its Micro Channel™ Architecture gave us an excellent platform to extend our TPS®/2 strategy. TPS®/2 is a multi-user, On Line Transaction Processing (OLTP) software package which can be used to distribute many transaction oriented applications for retail stores, airlines, manufacturing companies, and insurance firms, to name just a few.

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Walter A. Lindroth, President
Quadron Services Corporation
Santa Barbara, California

Quadron has been assisting developers with custom software, training and ARTIC development tools since 1956.



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Zak Wong, President
Network Software Associates, Inc.
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Network Software Associates, Inc. was formed in 1950 as a small company and has grown into a leading supplier of SAA/SNA communications software products.



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CIRCLE 144 ON READER SERVICE CARD

The Controversy Continues

If speed is your only priority, one of the 12 20-MHz 286s reviewed here may be just what you're looking for.

by John Dickinson

On the following pages, we review 12 new 20-MHz 80286-powered computers—which are certain to divide PC market-watchers into two groups. For some of you, 286/20s represent the first sign of a rebellion against the dominance of power-hungry hardware mavens who insist that the latest thing—in this case, an 80386-based PC—is always the right thing to buy. For the rest of you, these high-speed 286s are the last gasp from a dying generation of unloved microprocessors.

Both points of view have ardent proponents, people who have been known to square off in the hallways outside of user group meetings. Both points of view have merit in the light of the history of the PC market, especially in how 286- and 386-based machines have been perceived, sold, and used. Where you land in this great debate depends on how you view that history and what your PC needs are.

If speed is your only priority, one of the 20-MHz 286s reviewed here may be just what you're looking for. They are generally solid machines offering performance that is often equal to and sometimes better than equivalently clocked 386-based PCs. They all run DOS, and many of their vendors offer their own versions of OS/2. That means you can run just about any of the more-popular software currently on the market, supporting a conservative point of view that you don't need an expensive, top-of-the-line, 386-powered PC to do the job. Any 286-based PC will do just fine, and one of these 20-MHz 286s will do the job even better.

Unless, of course, your software requires the more sophisticated multitasking powers of an 80386. In that case, don't look here; the 80286 microprocessor used in these machines just won't run *Microsoft Windows/386* or *VM/386* or *PC-MOS*. And it certainly won't run the 80386-only



PHOTOGRAPH BY JONAS LIND

If you care to be ready and waiting when the future happens, you have to buy a 386-based PC. Now.

COMPUTERS
20-MHz 286 PCs

version of OS/2 that Microsoft and IBM plan to release in 1990. The more radical point of view is that if you need to be on the leading edge of the software game, or if you care to be ready and waiting when the future happens, you have to buy a 386-based PC. Now.

1990 AND COUNTING

That 1990 date is the rub here. There are 386-only software products on the market today, but they hardly represent the mainstream of this industry. They will someday, make no mistake. But that day is not today, and it's unimaginable that 386-only software products will even begin to dominate this industry before the '90s. By that time, of course, we'll be looking at the leading edge of software designed to run on Intel's new 80486 processor—and you'll be looking for your next PC.

You see, software, not hardware, determines how computers are used. Hardware, on the other hand, often determines how computers are perceived. That's usually because there's something alluring about going fast. It doesn't matter very much whether you're traveling in a car or a boat or just reading a book. Going quickly always seems preferable to going slowly. So it is with PCs, and thus we're running the eternal race to make faster desktop computers.

Every time you hear about a new PC product or technology, the first thing you learn is how much faster it is. Only then does someone bother to tell you how much more powerful and sophisticated it is. This was just as true in 1984, when IBM introduced its revolutionary PC AT, as it was in 1986, when Compaq introduced the first 386-based PC.

That first AT ran Intel's then-new 80286 microprocessor at a clock speed of 6 MHz, and most machines were purchased with the optional 20MB hard disk. That's barely alive and functioning by today's lofty desktop computer standards. But in their time, those ATs were the fastest things around. They defined power desktop computing.

The original 80286 not only ran faster than the earlier 8086 and 8088 processors, but it was also much more powerful. Besides its ability to run all 8086/88 software, the 286 microprocessor includes a protected mode of operation that allows multiple programs to be run simultaneously, a capability that many desktop PC power users wish they had.

Although IBM promised to deliver a

multitasking operating system for the AT someday, that system (later to be known as OS/2) was not made available until late in 1987. As a result, despite the presence of a few versions of Unix for the 80286, 286-based multitasking has gone virtually nowhere during the 5 years that AT-class machines have been with us. Almost all 286s in use today run MS-DOS, the venerable 8086/88 operating system proffered by IBM and Microsoft since the earliest days of the PC. These 286s run the same word

There's nothing
sleepy about a 12.5-
MHz desktop PC
running DOS and a
good word processor.

processing, spreadsheet, and database programs that work on any other DOS machine.

In fact, the fairest description of a typical 286-based PC is that it's really just an XT running the same programs faster. That assessment has remained true even as the clock speeds for 286s climbed from 6 MHz through 8 MHz to 12.5 MHz. In an age of DOS dominance, a speedy DOS machine is the machine of choice for power users.

Control of the power-user hill was taken away from the 286 when Intel introduced the 32-bit, multitasking-capable 80386 processor and Compaq stuffed it into an AT-like machine in 1986. The 386 processor is yet more powerful than the 286 that preceded it. Not only does it include multitasking support, but the multitasking is more sophisticated and the processor can also operate multiple virtual 8086 PCs. That capability has made possible such DOS-compatible multitasking operating systems as VM/386, PC-MOS, and Windows/386. The 386 also runs OS/2, but it operates more like a 286 than a 386 when it does.

Of course, when 80386-based computers first made it onto the PC scene, OS/2 was no more available for those machines than it was for their 286-based cousins.

Nor were any of the 386-only operating systems. At the time, the only advantage offered by a 386 was its faster 16-MHz clock speed. The power-user hill was taken over by yet faster machines running the same DOS programs that were running on the 286s and 8088/86s that came before them.

The result of these developments was that 286-based PCs became the computer of choice for entry-level users. There's nothing sleepy about a 12.5-MHz desktop PC running DOS and a good word processor or spreadsheet program. Entry-level users became more productive as the cost of AT-class machines came down, relieving us of further suffering at the hands of 4.77-MHz XT-class machines.

MUDDY WATER

Two more-recent developments have muddied the PC waters and messed up this easily defined hierarchy. First, in mid-1988 Intel introduced a low-cost, 16-bit version of the 80386 called the 80386SX. The new chip offers all the 32-bit processing horsepower, multitasking, and virtual-memory sophistication of a full-blown 386. But the new chip uses a less expensive 16-bit memory design and a slower 16-MHz clock speed to reduce the cost of both the chip and the computer that can be built around it.

The second development came from two Intel licensees, Harris Corp. and AMD (Advanced Micro Devices) have come up with methods of manufacturing 80286s that produce chips capable of running considerably faster than the 12.5-MHz top speed of Intel's original 286 processor. Both firms make 16-MHz 286s, and Harris ships one capable of 20 MHz—the chip used in most of the PCs tested in this review. Both companies have announced plans to produce a 25-MHz 286 chip in 1989.

Both new processor technologies have been positioned as logical successors to the 12.5-MHz 80286 chip still being manufactured by Intel. Since each processor offers users the mainstream software capabilities of DOS and OS/2—at higher processing speeds than are available in AT-class machines—both technologies appear to have a legitimate claim of succession.

That legitimacy is strengthened by the fact that each processor is designed to work in a hardware environment similar to any 286-based PC. The biggest difference in hardware design between an AT-class machine and a 20-MHz 286 or 16-MHz

CRYSTALS, COMPONENTS,
AND THE DANGERS OF SPEED

by Winn L. Rosch

The easiest way to make a computer run faster is to increase the frequency of its system clock. It's something like giving steroids to your system—but like a runner's body, your computer will suffer side effects that can be serious and, in the long run, debilitating.

There's no secret to boosting performance by swapping crystals. Way back in 1984, *PC Magazine* noted that you could increase the performance of the original AT by 33 percent simply by exchanging its original crystal—which set the machine's operating speed at 6 MHz—for one that generated 8 MHz.

The speed-governing crystal that performs this magic is exactly what its name indicates, a sliver of quartz that has the amazing properties of flexing when it gets a jolt of voltage, then resonating at a constant speed. Because of these qualities, crystals are preferred for making oscillators with precisely controllable and unvarying frequencies. In PCs, the crystals are contained in sealed metal cans that eliminate environmental factors that could affect their physical and electrical properties. Most computers use crystals that oscillate at twice the system clock frequency (thus, a 40-MHz crystal is used in a 20-MHz 80286 machine).

Crystals are cheap—you can buy one at Radio Shack for \$1.99—so putting a higher-frequency crystal inside a computer is practically free. But unless the computer system and all of its components are designed for the higher crystal frequency, such a megahertz injection can cause crippling, even deadly, problems for your system. Some circuit elements just can't take higher speeds. (Our advice about jazzing up the AT took advantage of the components of the AT, which were rated to operate at higher speeds than the factory-original crystal allowed.)

Nearly half of the machines in this roundup may present difficulties even without your swap-

ping in a higher-speed crystal; their circuitry includes components rated for speeds lower than the 20 MHz indicated on the label. The manufacturers have chosen to operate components beyond their ratings because high-speed chips have perennially been in short supply, often unobtainable by smaller manufacturers. Moreover, higher speed ratings cost more. Using components boosted over their ratings is just another way of cutting corners and keeping prices down.

The penalty is reliability. When you have overscillated components inside your computer, the best you can hope for is suffering an occasional soft error. Now and again a spurious signal can change a bit of memory or the state of a signal coursing through the circuitry. The errant signal will register as an error that can cause your computer to shut down immediately, causing you to lose whatever you were working on. If it's any consolation, you can reboot the machine and start over—with the potential of the same problem recurring at random. In other words, a boosted component can act like a demon that has taken up residence inside your PC and occasionally pokes the problem button just to ensure you don't get too complacent about component ratings.

On the other hand, an overscillated component can also result in the nastier problem of the hard error. When the hard error occurs, you lose not only your work but also your computer. Once your beloved PC shuts down because of the catastrophic failure of the

Pushing your computer's chips past their ratings is an effective means of squeezing out some extra performance, but it can be fatal to your hardware.

underrated component, you can't bring the chip or your system back to life. Repair means a trip to the service center, a chip replacement, and a hefty bill. Worse, overworked chips often make suicide pacts: when one goes, it may take several others with it.

Even the manufacturers who make the machines that operate components beyond their ratings recognize the potential problems. Many (including Astrid Computers and Micro Express) are making efforts to secure supplies of chips with the proper ratings and are upgrading their products with the higher-speed chips. DataWorld, by contrast, shifts some of the risk to you. You have your choice of living with risky components or paying \$125 more to get chips designed for the DataWorld Data 286-20's operating speed.

Investing in a computer that's built from boosted chips is chancy at best. The chip manufacturer gives no guarantee that its products will even work at speeds higher than their ratings (which would defeat the ratings' entire purpose). You're left to rely on the vendor's warranty. As with any warranty, it's only as good as the company backing it up; when the warranty runs out you're on your own.

Oscillator speed (MHz) = System speed (MHz)
2



386SX machine involves the construction of a memory configuration compatible with the higher speeds of these processors. That means using paged interleaving or some other design that won't slow down the processors by inserting memory wait states.

Such solutions make the speedier machines more expensive, even before you consider system board and cabinet designs that minimize EMI (electromagnetic interference). In fact, the memory designs required by these processors are not unlike the designs used in high-speed, full-scale 386-based PCs. While both processors use 16-bit RAM chips—which are less expensive than 32-bit chips—they need to be rated at speeds of 100 nanoseconds or less. Those chips are more expensive than the 120-ns. chips generally used in 12.5-MHz PCs. If you're willing to settle for lesser performance, most designs for either processor can also use less-expensive, standard 16-bit memory boards made for the AT expansion bus.

More to the point, PC vendors have not rushed 386SX-based PCs to market. Only ten were available for review when *PC Magazine* published its massive 386 blockbuster issue (May 30, 1989). Vendor hesitation has been caused by the high cost of the 386SX, a situation Intel recently corrected by cutting the processor's price in half. The new pricing lined it up more directly against Harris's 20-MHz 80286 chip, and several new machines have been announced in response to the price cut. In addition, Intel will soon make building 386SX-based machines even more attractive by offering options designed to enhance the performance of the processor.

One last hardware phenomenon you have to consider when looking at high-speed PCs is the low-cost standard 386. Some vendors offer 16-MHz 386-based PCs that can be purchased—fully loaded with a 40MB hard disk and monochrome graphics display—for under \$3,000. Machines in this class tend to make the whole question of fast 286s academic. Why settle for anything less than a 386 when you can buy one for less money than any less-sophisticated alternative?

The average price of a 20-MHz 286 is about \$1,800 without video or hard disk installed. A comparable 386SX-based machine goes for around \$2,500. You would expect to install comparable disk and video equipment, so that shouldn't make any difference in the price. At least for the time being, 386SX technology will cost you

about \$700 more than fast 286 technology.

That's \$700 you don't have to spend, but you just might want to. It depends on whether you're confident about 286 technology. If you believe that 286 technology is a dying breed and that you will require 386 software within the life of this PC purchase, then it's \$700 you'll definitely want to spend.

You may want to spend even more. It's your call.

ASTRID COMPUTERS INC.

Astrid 286/20

All reviews by Winn L. Rosch

If you need to prove to your peers that you're a power user, Astrid Computers' 286/20 will make the point. The big tower shouts to the world its 20-MHz speed with a bold double-digit display.

The Astrid 286/20 won't let you down once you go to work, either. The machine delivers near-zero-wait-state performance, almost instant disk performance with an optional cache controller, and commodious drive accommodations. It may sound expensive, but its \$2,410 base price (no monitor, no hard disk) is only a rough indication of what you can expect to pay; actual pricing of the 286/20 is left to the dealers who sell it.



Although large (24 by 7 by 15½ inches, HWD) the tower-style upright case of the 286/20 holds a small Trillian 286MX system board that matches an XT board in size (Trillian Computer Corp. is the parent company of Astrid). The same board is also available from Astrid housed by standard AT-size and small-footprint cases.

CHIP SET CIRCUITRY

The system board is unusual; its principal circuitry, the Chips and Technologies NEAT chip set, uses surface-mount construction and is adapted to the conventional pin-in-hole technology of the system board. While this round peg/square hole design expedient should not affect performance or our recommendation of the Astrid, an odd aspect of its microprocessor does. Literally glued to the top of the chip is a heat sink, obscuring the origin and speed rating of the chip.

While heat sinks are normally a good feature, this combination falls short—it's an LCC (leadless chip carrier) sink atop a PGA (pin-grid array) chip. The chip underneath is not fully rated for the 20 MHz of the system because no 20-MHz 80286 chips are currently available in the PGA package. According to Astrid, the company has shipped nearly a thousand similar systems without any problems caused by the chip, and it guarantees the system's operation at 20 MHz. However, the system board is being revised to accommodate fully rated chips.

The Astrid 286/20 has an extra full-height internal drive bay, for a total capacity of seven half-height devices. Note that the electronics for the digital display are rather weakly supported. The price is a little high—\$4,268 for a 1MB system with 68MB hard disk and VGA monitor.



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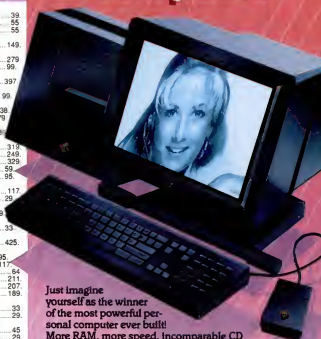
Logitech Mouse

The mouse that "shifts gear" to allow both fast and pixel-accurate cursor movement. Sleek ergonomic design plus a host of useful utility software (incl. 1-2-3 interface) should make the Logitech Mouse a winner. (Input Devices) \$85.

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DRIVES

Amdex	
Laserdrvs 1 CD-ROM	619
Arlatote Industries	
Hardpac 40	Call.
Iomega	
Bernoulli Box II/44 Int.	992
Bernoulli Box II/44 Ext.	1339
Plus Development	
Hard Card 40Mb	649
Plus Passport 40Mb	569
Plus Impulse 80Mb	869
Seagate	
30Mb HH Hard Drive (65ms XT)	279
30Mb FH Hard Drive (28ms AT)	579
TEAC	
5 1/4" 360K Floppy Drive	75
3 1/2" 1.44Mb AT Floppy Drive	109
3 1/2" Solutions for PC/XT	
1.44Mb Floppy & Ctrl.	157
720Kb Floppy & Ctrl.	137



Quicken 2.0 (Intuit)
Quicken 2.0 balances your checkbook, reconciles your bank accounts, even writes your checks! This personal financial program tracks and provides financial reports on just about everything you and your small business can need. (Business) \$28.

EXPANSION & UPGRADES

AST Research	
SePackPlus 384K	279
SePackPlus MC-512K	519
Fifth Generation	
Logical Connection 256K	429
Hercules	
Graphics Card Plus	175
Intel	
8087/80287/80387 co-processor	Special
Aboveboard Plus 512K	399
Inboard 386-PC w/1Mb	589
Orchid Technologies	
Designer 800	235
Request! II Z w/ok	189



Quadram	
Quad 386XT	Special
Video 7	
VEGA Deluxe	209
FastWrite VEGA 256K	309

INPUT DEVICES

Data Desk	
Turbo 101 Keyboard	109
Keytronic	
101 Plus Keyboard	95
Kraft	
3-button Joystick	29
Joystick Adapter Card w/cable	24
Logitech	
The New Mouse	85
Scanman	189

Lappac Deluxe (Targem)
For unsurpassed quality and design, the Lappac Deluxe is the laptop carrying case of choice. Featuring Zilcone treated durable nylon shell, cushioned shoulder pads and hand grips, shock absorbing rubber feet, rugged zippers and reinforced stress points, it offers additional compartments for disks, documents, pens, business cards - even for a portable printer. Available in "flight bag" and "brief case" styles in black nylon or luxurious leather. (Accessories) in nylon \$49. In Leather Call.

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- UPS ground delivery and actual freight charges apply for computers, hard disks, Bernoulli's, tape back-ups, monitors and printers
- Alaska, Hawaii, outside continental U.S. - APO/FPO call for information

*Defective software replaced immediately. Hardware replaced or repaired at our discretion.

Item availability and price subject to change without notice.
Software is not copy protected, except where marked by asterisk.

CONTEST RULES 1. Entries must be received on or before 6/30/89. 2. Winners selected in random drawing by Micro Warehouse Inc. (MWH), whose decisions are final. 3. Next Contest prize subject to availability. MWH reserves the right to substitute wholesale cash value up to \$10,000. 4. Winners responsible for taxes. 5. Odds of winning depend on number of entries. All prizes will be awarded. 6. MWH will announce the winners on or around 7/31/89. Winners notified by mail. Odds subject to change at the discretion of MWH. If unable to contact any winner, an alternate will be selected by random drawing. 7. Contest is open to US residents, except where prohibited by law. Employees of MWH and affiliates not eligible. 8. Prizes - one Next Computer including keyboard and monitor and 150 software and media products.

Microsoft	
Mouse w/Easy CAD 2.0 (bus/ser)	107
Mouse w/Painterbrush (bus/ser)	95

MODEMS

Hayes	
Smartmodem 1200B w/soft.	279
Smartmodem 2400 Ext.	419
Practical Peripherals	
2400SA External	169
1200SA Mini External	75

MONITORS

NEC	
Multisync 3D	Special
Multisync 2A	475
Zenith	
ZCM1490 14" flat screen	595

PRINTERS

Citizen	
120D	139
180D	159
Panasonic	Call.



A front-panel turbo switch toggles both system speed and the speed display between 16 and 20 MHz. Clock speed can also be reduced to 8 MHz from the keyboard, although doing so does not affect the speed display. A socket is provided for a 10-MHz 80287 numeric coprocessor.

The NEAT chip set controls both the bus speed of the system (selectable from 6, 8, or 10 MHz) and the number of wait states imposed in accessing the Astrid's interleaved memory. The one-wait-state setting allows use of 120-nanosecond memory; zero-wait-state operation requires 100-ns. RAM and delivers performance on a par with all the other interleaved systems reviewed here.

The system board holds up to eight special SIP (single in-line package) memory modules of either 256-kilobit or 1-megabit capacity. The 256-kilobit SIPs in the evaluation machine were each made from two 4 by 256-kilobit chips and one 1 by 256-kilobit chip, all rated at 100 ns. SIPs must be added in banks of four. Possible system board capacities include 1 or 2MB with 256-kilobit SIPs, 4 or 8MB with 1Mb SIPs, or 5MB with one bank of each SIP size.

Thanks to the NEAT chip set, the Astrid 286/20 also features shadow RAM and EMS 4.0 hardware support for system board memory, both controllable through the SETNEAT program included with the system. The BIOS bears an Award copyright and includes the system setup program in its code.

Of its eight expansion slots, two are 8-bit interface, the rest 16-bit. The standard configuration fills one with an AT-type serial/parallel board with an additional serial port cabled out to the back panel through a 25-pin D-connector. Blanked

cutouts for three more 25-pin D-shells and a total of four 9-pin D-shells are also available here. In the base system, another slot is given over to an AT-style combined floppy/hard disk controller that may vary in brand.

TESTED CONFIGURATION

The evaluation system was equipped with a \$1,195 proprietary Trillian FastCache controller that's based on a design by Distributed Processing Technology. With its 512K hardware cache, the controller speeded up the already swift ESDI interface of the optional (\$1,896) 142MB Micropolis model 1355 hard disk to near instantaneous response.

The tower configuration of the system allows for a large number of mass-storage options. Three half-height drive bays have front-panel access, with one occupied by a high-density 5¼-inch or 3½-inch floppy disk drive as standard equipment. The evaluation system had both—a TEAC FD-55GFR and a TEAC FD-235HF. An internal bay underneath will hold one full-height or two half-height hard disks, as will another bay at the very top of the machine. Drives mount directly, with screws through the side of the drive bay instead of rails. Guides for aligning floppy disk drives are an apparent afterthought—small brackets that screw into the outside of each drive bay.

Although the 230-watt power supply should give you enough juice to run them all, you'll need some kind of adapter because only four power connectors are attached to it. A rechargeable nickel-cadmium battery is soldered to the system board to power the built-in clock and CMOS setup memory. A connector on the system board allows you to supplement the on-board battery.

While the upright chassis itself is quite rigid and strong, it has its weaknesses. The flipper feet upon which it stands proved wobbly, and the control-panel circuitry for the turbo and reset switches and hard disk activity, power and turbo indicators, as well as the cylindrical key lock that controls the keyboard projects precariously inside the case. The potential for trouble here is small because the circuit board is, too.

WORKMANSHIP

Overall, workmanship is good—all cables are bundled, for instance—except for the system board aberrations. Even so, the As-

trid 286/20's construction scores only at the Class A level of FCC certification. The quality of the 286/20 is backed up by the ubiquitous 1-year parts and labor warranty and Astrid's overnight advance replacement program.

The base system includes a 101-key keyboard that follows the Enhanced layout. The Key Tronic product delivered with the evaluation unit featured a quiet, light touch (including the Spacebar) and good tactile feedback.

The optional display circuitry in the evaluation system included a \$428 Paradise VGA 16-Plus display adapter and an \$825 Trillian Everysync multiscanning display that proved to be a Tatung CM-1495 color 14-inch monitor.

The Astrid 286/20 is one of many computers in which the vendor's attention to details doesn't match its machine's excellent performance. Overlook the minor flaws, and you'll be rewarded with state-of-the-art 80286 performance in a tower case with expansion room galore.

COMPUADD CORP.

CompuAdd 286/20

Think of the CompuAdd 286/20 as just another one of those mail-order computers, and you'll be way off base. Although it won't win awards for trendy styling or engineering innovation, the low-priced, \$1,695 (no video or hard disk) machine shows more refinement and attention to detail than some expensive name-brand computers. And its near-zero-wait-state performance certainly won't disappoint the power-hungry.

The CompuAdd 286/20 begins with an unassuming AT case that's an entirely conventional blend of IBM design and the standard "improvements" added by most compatible manufacturers. For instance, besides the de rigueur cylindrical keyboard-and-chassis lock and power and hard disk activity indicators, the control panel includes a square blue reset push button and indicators for the system's two speeds.

DRIVES AND CONNECTORS

All three right-hand half-height drive bays have front-panel access and use AT-style drive rails. However, drives are secured by a screw that goes through the rail and directly into one of the drive's mounting



Astrid 286/20

Astrid Computers Inc., 372 Turquoise St.,
Milpitas, CA 95035; (800) 328-8286, (408) 942-
0096

List Price: With 1MB RAM, 1.2MB 5¼-inch or
1.44MB 3½-inch floppy disk drive, lower case,
\$2,410; with 68MB hard disk, monochrome
monitor, DOS 3.3, \$3,384; with VGA monitor,
\$4,268; with Trillian FastCache controller,
\$5,467.

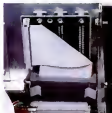
In Short: A lower-price computer with expansion
room to spare and performance to please, the
Astrid 286/20 has a few flaws to go along with its
design bonuses.

CIRCLE 396 ON READER SERVICE CARD

COMPUTERS
20-MHz 286 PCs



CompuAdd's 286/20 offers some solid workmanship for a more-than-respectable price: \$2,799 for 1MB RAM, 40MB hard disk, and VGA monitor. CompuAdd builds the circuitry for its standard-equipment ports onto its system board. The connectors for these ports are tied to the system board via a neatly dressed ribbon cable. The large ferrite slug encircling the cable helps to keep down radio emissions for a Class B FCC rating.



holes rather than by front-panel brackets. Although the drives do not slide smoothly into place, the mounting proved adequately secure.

One floppy disk drive bay in the evaluation machine was filled with the standard-equipment high-density 5¼-inch floppy disk drive, a Japanese-made Newtronics Company Ltd. unit. The full-height internal bay in the evaluation machine was blessed with an optional (\$569) Miniscribe 6085 hard disk with 71MB formatted capacity and widely used 5-MHz ST-506/412 interface.

The center of the rear panel boasts the addition of two male 25-pin D-shell connectors for serial ports and one 25-pin male parallel port. The I/O circuitry for these ports is built into the system board with the connectors attached to a small circuit board. This board is tied in by a ribbon cable wrapped with a ferrite slug to keep radio frequency emissions down. Evidently these and other anti-RF treatments were successful—the 286/20 earned the stringent FCC Class B rating.

DESIGN FORETHOUGHT

Inside the case, CompuAdd shows design forethought at its best, distinguishing the company from some of its peers. The battery holder for the four AA cells that run the CMOS clock and setup memory is spot-welded into place on top of the hard disk bay. The ferrite slug around the I/O cabling snaps into place on a rear-panel bracket. In fact, only one detail was over-

looked—the front-panel hard disk activity indicator was not plugged into the disk controller.

The system board bears CompuAdd's own imprimatur. It's primarily built around the Chips and Technologies NEAT chip set, fully rated at 20 MHz, as is the Harris 80C286 microprocessor. For compatibility purposes, the system clock can be slowed to 8 MHz. A 40-pin DIP socket awaits the installation of an 80287 numeric coprocessor, which must be rated at 8 MHz or better.

MEMORY

The base memory of the system, 1MB made from 36 256-kilobit DRAM chips, is hidden under the drive bays. Additional system board memory can be added in the form of readily accessible SIMMs (single in-line memory modules). Either 256-kilobit or 1-megabit SIMMs can be used in the four sockets to endow the 286/20 with up to 5MB of high-speed RAM.

Physically, memory is interleaved to achieve what CompuAdd calls zero-wait-state performance. In testing, however, the 286/20 did no better than systems with interleaved memory that delivered "near-

zero-wait-state" operation. Logically, the first 384K over the DOS 640K can be used for shadow RAM courtesy of the machine's NEAT chip set, which also gives full EMS 4.0 hardware support to system board RAM.

Of the eight expansion slots in the 286/20, two use the 8-bit PC bus and six use the 16-bit AT bus. All slots operate at 8 MHz. In the evaluation machine, two 16-bit slots were filled, one with a Paradise VGA-16 Plus display adapter, another with a Western Digital WD1006V-MM2 floppy/hard disk controller. The standard-equipment controller is a Western Digital WD1003-WA2.

OTHER FEATURES

Although the 200-watt Astec power supply has only three power cables for drives, two of them are each equipped with two connectors; this arrangement lets you plug up to five devices into the 286/20 without the need for adapters. A slide switch on the rear panel selects either 115- or 230-volt operation at 50 or 60 Hz, and a switched outlet is available for connecting displays.

The keyboard accompanying the 286/20 follows the Enhanced 101-key layout and was manufactured by Key Tronic. Although quiet, it delivers good tactile feedback marred only by the inordinately high force required to actuate the Spacebar. The evaluation system was also accompanied by an exemplary Zenith ZCM-1490C, a 14-inch flat tension mask color VGA display.

CompuAdd backs the 286/20 with a 1-year warranty and a 30-day money-back guarantee. Some productivity software is included with the system (a file manager, a text editor, and PC Fullback backup software) but DOS 3.3 or 4.1 is an \$89 option. CompuAdd does not deal in OS/2.



FACT FILE

CompuAdd 286/20
CompuAdd Corp., 12303 Technology Blvd., Austin, TX 78727; (800) 627-1967
List Price: With 1MB RAM, 1 2MB 5¼-inch or 1 44MB 3½-inch floppy disk drive, \$1,895; with 40MB hard disk, monochrome monitor, DOS 3.3, \$2,249; with VGA monitor, \$2,799; with 80MB hard disk, \$3,045.
In Short: CompuAdd builds competent machines at low, low prices, and the 286/20 is no exception. This system demonstrates particularly outstanding attention to detail in addition to speedy benchmark-test results.

CIRCLE 397 ON READER SERVICE CARD



20-MHz 286 PCs: SUMMARY OF FEATURES

The following commentary analyzes some of the terms in this table of features. The phrases in bold type are listed in the same order as in the left-hand column of the table.

Basic configuration This price represents the most stripped-down machine the vendor will sell, typically including 1MB RAM, one floppy disk drive, and serial and parallel ports. Note that these prices are not always strictly comparable because some vendors will not sell their computers without a hard disk or with less than 2MB RAM. Therefore, when comparing products, please consult the "standard configuration" prices as well. (All prices in this features table are subject to change.)

Cost of OS/2 (if available) OS/2 can sometimes be purchased with a system, but it is not available from all vendors.

Hard disk options For buyers seeking specific configurations, some vendors offer more flexibility than others. The number of different hard disks the vendor offers for a machine is often indicative of how much customizing is available. Keep in mind that it is sometimes far more cost-efficient to buy your computer and hard disk from different vendors.

Standard configuration For the sake of price comparisons, our "standard" configuration normally includes 1MB RAM, a 60MB hard disk, at least one floppy disk drive, a monochrome monitor, at least one parallel and one serial port, DOS, and a keyboard. Because the closest approximation of our standard package may differ from this configuration, the price of each system is followed by the total RAM (if the package includes more than 1MB) and the size of the hard disk (if other than 60MB). Where no price appears, the vendor does not sell a system that conforms to at least five of the parameters we have designated for a standard machine—which means merely that the reader will have to use other information in comparing prices.

Tested configuration The specifications of the evaluation units depend on what configuration each manufacturer has sent us (based on our guidelines).

Bus clock speeds Bus speed becomes more important as computers run at faster clock speeds. A computer's bus speed may actually be too fast for expansion cards, most of which operate at 8 or 10 MHz. Time-out periods, sometimes called wait states, are often used to slow down the bus.

Disk controller manufacturer and type (interface/encoding) Several interfaces are used to control the way data is transferred from the hard disk to the computer. The most common disk interface standard is ST-506/412, used in the IBM PC-XT and PC AT. Two other common data transfer interfaces are SCSI (Small Computer System Interface) and ESDI (Enhanced Small Device Interface). Both SCSI and ESDI require special hard disk controllers and cannot run off existing PC-XT or PC AT controllers.

Disk encoding techniques currently include RLL (Run Length Limited) and the older MFM (Modified Frequency Modulation) scheme. All data is encoded onto and read from your hard disk as a series of polarity-reversing bits representing ones and zeros. Nine such bits would be needed to store 12 bits of data in MFM format, and only six polarity changes are required with RLL format; thus, MFM takes more space than RLL but provides a more stable environment and is more commonly used. ST-506 technology, for instance, uses the MFM encoding scheme.

BIOS version and date The BIOS date is important to those planning to use 3½-inch disk drives. Early BIOS versions cannot handle this format. (In some cases the vendor would not release this information.)

Memory chip type Kb and Mb refer to kilobits and megabits, respectively.

Chip packaging Memory chips come in a variety of styles: DIPs, SIPs, and SIMMs. The Dual In-Line Package (DIP) is the traditional buglike computer chip sprouting 8, 14, 24, or even 40 or more metal legs (evenly divided between right and left sides). Single In-Line Packages (SIPs) are single-package arrays of computer chip logic assembled so that all connecting legs are in a straight line, like the teeth on a

comb.

Single In-Line Memory Modules (SIMMs), on the other hand, are individual logic devices that are installed on their own small circuit board, creating a component module that can be plugged into a larger device. Their physical arrangement duplicates the integrated structure of a SIP but allows for the possibility of replacing an individual memory component if necessary.

RAM chips RAM chips come in two basic types: static and dynamic. Static RAM chips (SRAMs) are faster and more efficient but costlier. Dynamic RAM chips (DRAMs) cost less and are more common, but the tradeoff is in slower processing and operation.

Interleaved memory CPU speed is usually faster than memory speed. Interleaved memory increases processing speed by splitting the memory into two or more portions. The CPU then sends information to a section at a time, allowing one section to process while another receives data.

Shadow RAM Shadow RAM is a technology that loads system BIOS and/or video BIOS directly into fast RAM on board of the computer. The BIOS then operates much faster.

Disk cache software Some companies provide their own software to facilitate caching. Other computers can generally take advantage of the caching facility within some version of DOS.

FCC certification class Two classes of FCC (Federal Communications Commission) approval may be given to computers: Class A and Class B. These classes concern levels of radio-frequency interference. With Class A approval, a computer may be operated in a business locale. The tougher Class B rating allows home use as well, where computers are likely to be placed near radios and television sets.

Certification tests must be performed by private testing companies. The passing results are then sent to the FCC for final

(CONTINUES)

COMPUTERS
20-MHz 286 PCs



20-MHz 286 PCs: SUMMARY OF FEATURES

BASIC CONFIGURATION

	GenTech 286/20	DataWorld Data 286-20	CompuAdd 286/20	Star AM 286-2240	ME 286-20
List price	\$1,199	\$1,555	\$1,895	\$1,814	\$1,899
Basic configuration includes	1MB RAM, 1.2MB floppy disk drive, one serial and one parallel port, EMS driver	1MB RAM, 1.2MB floppy disk drive, monochrome display adapter, one parallel port	1MB RAM, 1.2MB or 1.44MB floppy disk drive, two serial and one parallel port, utilities	1MB RAM, 1.2MB floppy disk drive, Hercules video adapter, two serial and two parallel ports, mouse	2MB RAM, 40MB hard disk, 1.2MB or 1.44MB floppy disk drive, one serial and one parallel port, EMS driver
Drive bays	5 half-height	5 half-height	4 half-height	4 half-height	5 half-height
Cost of OS/2 (if available)	Unavailable	\$319	Unavailable	\$249	\$275
Hard disk options	2	4	4	4	4
Slots	Two 8-bit, six 16-bit	Two 8-bit, six 16-bit	Two 8-bit, six 16-bit	Two 8-bit, six 16-bit	Two 8-bit, six 16-bit
Slots free with hard and floppy drives, video, two serial and one parallel port installed	5	5	5	5	5
Power supply (watts)	200	180	200	200	220
Keyboard cable length (inches)	72	84	72	120	72

STANDARD CONFIGURATION

Price of monochrome system with 1MB RAM, 60MB hard disk, DOS	\$1,989	\$2,019 (66MB disk)	\$2,249 (40MB disk)	\$2,499	\$2,418 (2MB RAM, 80MB)
Price of VGA system	\$2,409	\$2,694	\$2,799 (40MB disk)	\$3,044	\$3,018 (2MB RAM, 80MB)

TESTED CONFIGURATION

List price	\$2,409	\$3,778	\$3,562	\$3,995	\$4,528
Tested configuration includes	2MB RAM, 65MB hard disk, 1.2MB floppy disk drive, VGA monitor	2MB RAM, 65MB hard disk, 1.2MB floppy disk drive, VGA monitor, DOS 3.3, tower case	2MB RAM, 71MB hard disk, 1.2MB floppy disk drive, VGA monitor	1MB RAM, 60MB hard disk, 60MB tape backup, 1.2MB and 1.44MB floppy disk drives, VGA monitor	4MB RAM, 147MB hard disk, 1.2MB floppy disk drive, VGA monitor
Microprocessor clock speeds	8/10/16/20 MHz	10/20 MHz	8/20 MHz	10/20 MHz	8/20 MHz
Bus clock speeds	8 MHz	10 MHz	8 MHz	10 MHz	8 MHz
Wait states	0, 1	0, 1	0	0	0, 1

Disk controller manufacturer and type (interface/encoding)	Western Digital (ST-506/RLL)	Data Technology Corp. (ST-506/MFM)	Western Digital (ST-506/MFM)	Data Technology Corp. (ST-506/MFM)	Data Technology Corp. (ESDI)
Number of drives handled by controller	4	4	4	4	4
BIOS version and date	Phoenix BIOS, Version 3.10 (December 1988)	Award BIOS, Version 3.03 F1 (November 1985)	Award BIOS, Version N3.03 (December 1988)	Phoenix BIOS, Version 3.10 (November 1988)	Award BIOS, Version 3.03 (December 1988)
System board manufacturer	JC Information	Informtech	CompuAdd	TMC Research	Informtech
286 chip set manufacturer	Chips and Technologies	Chips and Technologies	Chips and Technologies	Chips and Technologies	Chips and Technologies

MEMORY SPECIFICATIONS

Memory chip types	256Kb	256Kb	256Kb, 1Mb	256Kb, 1Mb	256Kb, 1Mb
Chip packaging	DIP	DIP	SIMM	DIP	DIP
RAM chips	DRAM	DRAM	DRAM	DRAM	DRAM
Interleaved memory	●	●	●	●	●
Shadow RAM	BIOS and video	BIOS and video	BIOS and video	BIOS and video	BIOS and video
Disk cache software	●	●	●	●	●
Maximum RAM on motherboard	4MB	2MB	5MB	4MB	8MB
Maximum total system RAM	16MB	16MB	16MB	16MB	16MB

OTHER

Warranty	1 year; 30-day money-back guarantee	1 year; 30-day money-back guarantee	1 year; 30-day money-back guarantee	1 year	15 months
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FCC certification class

A (pending)	A	B	A (B pending)	B
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Editor's Choice
 Yes
 No

COMPUTERS
20-MHz 286 PCs

PC Craft 2100/20 \$2,055	Vector Excalibur 286 \$2,095	Zeos 286-20 \$2,095	Northgate SuperMicro 286/20 \$2,399	Astrid 286/20 \$2,410	Dell System 220 \$2,295	Wells American Computer 286 \$2,615
1MB RAM, 1.2MB or 1.44MB floppy disk drive, DOS 3.3, EMS driver	1MB RAM, 1.2MB floppy disk drive, one serial and one parallel port, DOS 3.3, EMS driver	1MB RAM, 32MB hard disk, 1.2MB floppy disk drive, monochrome monitor, two serial and one parallel port, EMS driver	1MB RAM, 68MB hard disk, 1.2MB and 1.44MB floppy disk drives, mono- chrome monitor, two serial and two parallel ports, DOS 4.01, utilities	1MB RAM, 1.2MB or 1.44MB floppy disk drive, two serial and one parallel port	1MB RAM, 1.44MB floppy disk drive, monochrome monitor, VGA adapter, two serial and one parallel port	512K RAM, 1.2MB floppy disk drive, two serial and one parallel port
5 half-height Unavailable	3 half-height Unavailable	6 half-height Unavailable	4 half-height Unavailable	7 half-height Unavailable	3 half-height \$325	7 half-height \$325
4	3	4	5	8	2	6
Three 8-bit, five 16-bit	Three 8-bit, five 16-bit	Two 8-bit, six 16-bit	Two 8-bit, four 16-bit	Two 8-bit, six 16-bit	Three 16-bit	One 8-bit, six 16-bit
5	5	5	3	5	3	8
200	200	230	200	230	85	220
72	72	72	72	96	72	72
\$2,965 (65MB disk)	\$2,995 (65MB disk)	\$2,398 (65MB disk)	\$2,399 (68MB disk)	\$3,384 (68MB disk)	\$2,999 (40MB disk)	\$3,770 (42MB disk)
\$3,560 (85MB disk)	\$3,495 (65MB disk)	\$3,093 (65MB disk)	\$3,024 (68MB disk)	\$4,268 (68MB disk)	\$3,299 (40MB disk)	\$4,070 (42MB disk)
\$4,225	\$3,825	\$4,833	\$3,924	\$5,467	\$3,399	\$6,550
1MB RAM, 64MB hard disk, 1.2 MB floppy disk drive, VGA monitor	1MB RAM, 65MB hard disk, 1.2 MB floppy disk drive, VGA monitor	2MB RAM, 66MB hard disk, 1.2MB floppy disk drive, VGA monitor, DOS 3.3	1MB RAM, 155MB hard disk, 1.2MB and 1.44MB floppy disk drives, VGA monitor, DOS 4.0	2MB RAM, 142MB hard disk, 1.2MB and 1.44MB floppy disk drives, VGA monitor	1MB RAM, 100MB hard disk, 1.44MB floppy disk drive, VGA monitor, DOS 3.3	1MB RAM, 150MB hard disk, one 1.2MB and two 1.44MB floppy disk drives, VGA monitor
10/20 MHz	10/20 MHz	10/20 MHz	8/20 MHz	8/20 MHz	8/20 MHz	6/8/10/12/16/20 MHz
8/12 MHz	8/10 MHz	8 MHz	8 MHz	6/8/10 MHz	8 MHz	6/8/10 MHz
0, 1	0, 1	0, 1	1	0	0, 1	0, 1
National Computer League (ST-506/MFM)	Adaptec (ST-506/RLI)	Adaptec (ST-506/RLI)	Adaptec (ST-506/RLI)	Microplus (ESDI)	Conner (ESDI)	Adaptec (ESDI)
4	4	4	4	4	3	6
Award BIOS, Version 3.03 (December 1988)	Award BIOS, Version 3.03 (December 1988)	Phoenix BIOS, Version 3.10 (March 1988)	Award BIOS, Version 3.03 (December 1988)	Award BIOS, Version 3.03 (September 1988)	Phoenix BIOS, Version 3.10-18 (January 1988)	Wells American BIOS, Version C1.08
InfoMtech	InfoMtech	TMC Research	Northgate	Trillian	Dell	Wells American
Chips and Technologies	Chips and Technologies	Chips and Technologies	None (uses discrete logic)	Chips and Technologies	Chips and Technologies	Chips and Technologies
256Kb	256Kb	256Kb, 1Mb	256Kb, 1Mb	256Kb, 1Mb	256Kb, 1Mb	256Kb, 1Mb
DIP	DIP	DIP	DIP	SIP	SIMM	Proprietary
DRAM	DRAM	DRAM	DRAM	DRAM	DRAM	DRAM
●	●	●	●	●	●	●
BIOS and video	BIOS and video	BIOS and video	●	BIOS and video	BIOS and video	BIOS and video
●	●	●	●	●	●	●
2MB	2MB	4MB	4MB	8MB	8MB	16MB
16MB	16MB	16MB	16MB	16MB	16MB	16MB
1 year; 4 months on-site service	1 year; 3 months on-site service	1 year; 90-day money- back guarantee	1 year	1 year	1 year; 31-day money-back guarantee	1 year; 31-day money-back guarantee
A	A	B	B	A	B	A (B pending)

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The low entry fee and more-than-competent execution of the CompuAdd 286/20 make it a desirable, if not particularly innovative, workhorse computer.

DATAWORLD INC.

DataWorld Data
286-20

If the squat, minitower package that the DataWorld Data 286-20 comes in isn't enough to make you love it, its price or performance may win you over. At \$1,555 for a plain AT case with a digital monochrome adapter and display (no hard disk), \$75 more for the stubby tower, its price is near the bottom of the range for high-performance 80286s. Speed, on the other hand, is at the top. Despite its use of the same Informtech 286/Supra system board as was used in many of the other machines reviewed here, the DataWorld races fractionally ahead of the pack.

The little powerhouse measures 13½ by 7 by 16 inches (HWD) and looks great. It wears its control panel like a belt, an attractive medium-gray contrast to the white-beige machine. Controls here include a reset push button (with an orange warning dot in the center), a turbo push button, and a cylindrical keyboard lock. Indicators include the expected power, hard disk activity, and turbo mode. The power switch is also handily located.

The case is sturdy, heavy-gauge steel, and the workmanship is very good. One nice touch is the duplicate keyboard connectors on the front and rear panels.



SYSTEM BOARD AND SLOTS

The system board runs up the right side of the dwarf case, making the eight expansion slots (two 8-bit and six 16-bit) horizontal. One of the 8-bit slots also handles a proprietary 16-bit high-speed memory expansion board.

All slots have more than enough headroom for AT boards, but two (one 8-bit, one 16-bit) are shortened by the drive bays and limited to expansion cards measuring no more than 6 or 7 inches long. (Cables interfere with the ends of the board, so the exact maximum length depends on how cruel you want to be to the boards and the wiring.)

Standard equipment fills one slot with the monochrome display adapter, which also yields the standard equipment parallel port. The evaluation system filled the short 8-bit slot with an optional \$59 I/O card loaded with two serial ports and one parallel port. The primary serial and parallel ports are mounted on the card in typical AT fashion, while the secondary serial port is cabled out to the rear panel through a 25-pin connector. Two 9-pin cutouts remained available on the rear panel for installing the D-shell connectors of other option boards.

Another slot is filled by the factory with a Data Technology 7280 floppy/hard disk controller. The evaluation machine was equipped with an upgrade board, a DTC 7287 RLL controller. Instead of the monochrome display adapter, the evaluation machine held a 16-bit Video Seven Fast-Write VGA board.

The DataWorld Data 286-20 compensates for its low stature with a number of drive-mounting options. There's space for five devices—two half-height 5¼-inch

units and three half-height 3½-inch units, all but one of the latter with front-panel access. Standard equipment puts a 5¼-inch floppy disk drive (a TEAC FD55-GFR high-density in the evaluation system) in the topmost position. Drives are held in place by screws that attach them directly to the sides of the drive bay. Unfortunately, adequately securing the screws to the right side of the hard disk or the 3½-inch floppy disk drives requires removing the system board, a design flaw likely to arouse the ire of anyone attempting to add a disk to the system.



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Drives are held in place by screws that attach them directly to the sides of the drive bay. Unfortunately, adequately securing the screws to the right side of the hard disk or the 3½-inch floppy disk drives requires removing the system board, a design flaw likely to arouse the ire of anyone attempting to add a disk to the system.

The Informtech system board is little more than an implementation (and a successful one) of the Chips and Technologies NEAT chip set. As with other machines using this system board, the chip set is not rated for the full speed of the machine—the primary chips are boldly emblazoned 16 MHz. On the positive side, the Harris 80C286 microprocessor is rated for the Data 286-20's full 20-MHz speed.

If you or your software can't keep up with that rate, system board jumpers permit reducing the maximum speed of the system to 12 or 16 MHz. Or system speed can be reduced to 12 MHz on the fly either by pressing Ctrl-Alt-I or the front-panel turbo switch. Just to let you know that something has changed, the system beeps once and increases the size of the cursor to a blinking block.

The Informtech system board also allows you to set two speeds for the key-

PC
MAGAZINE
FACT FILE

DataWorld Data 286-20

DataWorld Inc., 3733 San Gabriel River Pkwy.,
Pico Rivera, CA 90660; (800) 722-7702

List Price: With 1MB RAM, 1.2MB 5¼-inch
floppy disk drive, monochrome monitor, \$1,555;
with lower case, \$1,830; with 20MB hard disk,
\$1,805; with 66MB hard disk, \$2,019; with VGA
monitor, \$2,694.

In Short: A neatly packaged minitower that ranks
at the top of the pack in terms of speed and at
the bottom in terms of price. The setbacks: the
microprocessor is rated at 20 MHz but the support
chips aren't; also, this machine lacks a Class B
rating from the FCC. If these factors don't faze
you, this machine is a terrific buy.

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286 12MHz 70MB	1567	1747	1907	1973
286 20MHz 40MB	1737	1917	2077	2143
286 20MHz 70MB	1937	2117	2277	2343
286 20MHz 90MB	2137	2317	2477	2543
386 20MHz 70MB	2537	2717	2877	2943
386 20MHz 90MB	2737	2917	3077	3143

CIRCLE 26 ON READER SERVICE CARD

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board controller—6 or 12 MHz. The bus speed, however, is fixed at 10 MHz.

If you need greater performance, you can add an 80287 numeric coprocessor into a designated socket on the system board. DIP switches let you select the operating speed of the chip at either 6, 8, 10, or 12 MHz.

The NEAT chip set in the Data 286-20 supports both shadow RAM and EMS 4.0. When shadowing is activated, up to 384K of the system's extended memory may be consumed by it. The BIOS bears an Award copyright and has the system setup program written into its code.

System board memory can range from 512K to 2MB in 512K steps, each step a bank made from four 4 by 256-kilobit chips and two 1 by 256Kb parity chips. All chips in the evaluation machine were rated at 100 nanoseconds. Memory is arranged in interleaved pages for near-zero-wait-state operation. The machine can also be set up to impose wait states in order to accommodate slower memory chips.

The jumpers that select the maximum master clock speed, bus speed, and keyboard speed are all hidden next to the internal hard disk bay. The system board must be removed to alter them. Because adjustments will likely worsen performance, you probably don't have to worry about making changes.

OTHER FEATURES

A tiny 180-watt power supply (200 watts in the standard AT case) is tucked into the top rear corner of the case and operates only on 110-volt line current. Four connectors are available for powering disk drives. Attached underneath the power supply with Velcro is the Rayovac 844 battery that supplies current to operate the CMOS setup memory and clock when the system is turned off.

The keyboard included with the Data 286-20 was a Taiwan-made Focus Electronics model that followed the 101-key Enhanced layout. The Focus keyboard comes close to the IBM sound and feel even though it uses hard-contact technology. It came equipped with a hinged, smoked-plastic protective cover.

In lieu of the standard-equipment 12-inch Samsung monochrome display, the evaluation system was accompanied by a Tatung CM-1495 color 14-inch multiscanning display. The system's optional hard disk was a \$464 Toshiba MK134FA-1, a 44MB drive expanded to 66MB thanks to the RLL controller.

DataWorld provides two pieces of software with the Data 286-20—one that runs on the system and one for your VCR. The former is *PC Magazine's* disk caching program; the latter, an educational video called "Making the Connection: How to Set Up and Use Your PC." Only a mannequin's hand to hold yours could give more assurance during setup. If that's not enough, the 1-year warranty covers both parts and labor.

The package, the price, and a few percentage points of better performance are the prime reasons to consider the DataWorld Data 286-20. But with parts operated beyond their ratings, there's reason to approach the stubby little computer somewhat cautiously.

DELL COMPUTER CORP.

Dell System 220

Think of the Dell System 220 from Dell Computer Corp. as an IBM PS/2 Model 30 286 with real guts. Both machines are elegantly petite, prefer 3½-inch disk drives, and offer the same expansion capability: three full-size 16-bit AT expansion slots horizontally mounted on the left side of the chassis. Both machines have VGA circuitry (including an IBM-standard VGA feature connector), serial port, parallel port, and the two-drive floppy disk controller

built into the system board. Both rely on a hard disk with an embedded controller. And both are pricey—the Dell weighing in at \$2,295 with a VGA display but no hard disk, 40MB hoisting the tag up to \$2,999.

PERFORMANCE

The difference is performance. Where the IBM machine purrs along at a piddling 10 MHz, the Dell roars at twice that rate and gives you a second serial port and room for another disk drive to boot. And you can't classify the System 220 as an IBM copy—after all, this classic bus machine came to the market first.

Despite the diminutive 4 by 15 by 15¼-inch (HWD) case, the Dell is a heavyweight, both in materials and performance. Thanks to its interleaved memory, the System 220 scores near the top of the performance chart. Despite smaller dimensions, the metalwork of the System 220 is the same thick steel used by better compatibles. The result—a sturdy machine that will withstand abuse, good enough to earn FCC Class B certification.

The styling is attractive, with just the right pedestal to put your monitor on. At the business end, the front of the case has exactly what you need: the power switch, the two 3½-inch floppy disk drive bays, a hard disk activity indicator, and an unusual keyboard-and-case lock. It's unusual because the mechanism of the lock is built into the front-panel bezel, part of the lid. Rotate the flat key, and a metal arm contacts a microswitch that's part of the chassis to lock the keyboard.



Dell doesn't just avoid using oversold components in the Chips and Technologies chip set in the Dell System 220; in one case the company provides a wide safety margin. The chip pictured is rated at 38 MHz. A top choice, this system sells for \$3,299 with 1MB RAM, 40MB hard disk, and VGA monitor.





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CIRCLE 111 ON READER SERVICE CARD



BENCHMARK TESTS: 20-MHz 286-BASED PCs

Even the fastest 286/20 registers only at the middle of the 386/20 scale established by the recent 386 blockbuster issue (May 30, 1989). Still, the Wells American CompuStar 286 bears

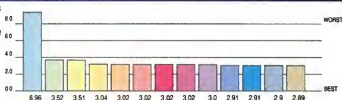
a closer look for its six first-place finishes, as does the Dell System 220 for overall performance and construction (in spite of timings that are sometimes below average).

PROCESSOR AND MEMORY BENCHMARK TESTS

80286 Instruction Mix

Elapsed Time (seconds)

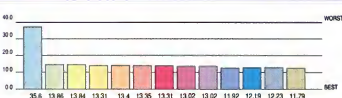
The 80286 Instruction Mix benchmark test times a series of tasks specific to the 80286 chip. Since this test shows how the CPU operates in the context of the bus, processor, system memory, and motherboard architecture, a faster time means better overall computer performance.



Floating-Point Calculation Without Coprocessor

Elapsed Time (seconds)

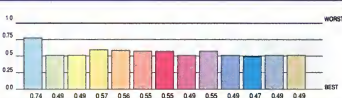
The Floating-Point Calculation Without Coprocessor benchmark test sets up a floating-point emulation program in RAM and then exercises the processor and tests RAM access speeds during floating-point calculations.



Conventional Memory

Elapsed Time (seconds)

The Conventional Memory benchmark test measures the read/write speed of the first 640K of memory. Slower relative times can indicate the presence of memory wait states or memory chips rated at slower access speeds.

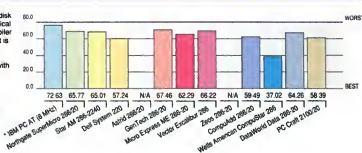


DISK BENCHMARK TESTS

DOS File Access (Small Records)

Elapsed Time (seconds)

The DOS File Access (Small Records) benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. The test is performed without software disk caching. Fast times are advantageous for programs that work with many short segments of data.



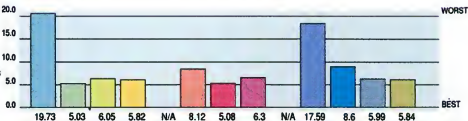
N/A—Not applicable: this machine's hard disk BIOS was not compatible with our tests.

* This product was not reviewed, but we are reporting its test results for comparison.

DOS File Access (Large Records)

Elapsed Time (seconds)

The DOS File Access (Large Records) benchmark tests disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. This test minimizes the effect of small hardware caches on disk subsystem performance. It is performed without software disk caching. Fast times are advantageous when large files are loaded.



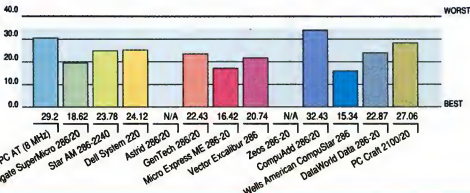
BIOS Disk Seek

Elapsed Time (milliseconds)

The BIOS Disk Seek benchmark test measures mechanical track-to-track disk drive access times. Fast times are helpful with programs such as databases, which often store and must later find data in many separate places on a drive.

N/A—Not applicable: this machine's hard disk BIOS was not compatible with our tests.

* This product was not reviewed, but we are reporting its test results for comparison.

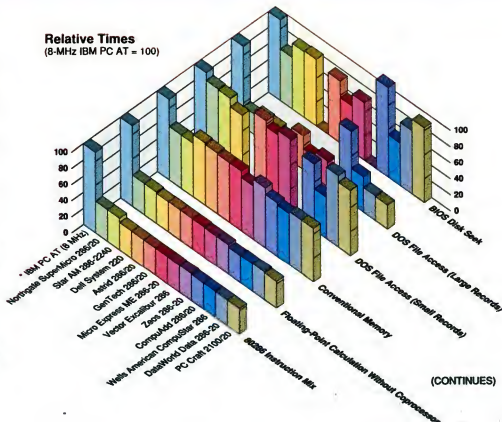


PROCESSOR, MEMORY, AND DISK BENCHMARK TESTS: COMPOSITE VIEW

The Nortage SuperMicro 286/20 wins the best/worst award in benchmark test results. Its fast video board enables it to score by most of the competition in video tests, yet the machine's slow microprocessor puts it at the bottom of the pack on both the 80286 Instruction Mix and Floating-Point Calculation tests (this is excluding the 8-MHz IBM PC AT, whose test results are reported for the sake of comparison). The Star AM 286-2240 suffers from a similar problem, although both computers are equipped with fully rated 20-MHz chips.

The CompuAdd 286/20 performs respectably on all but the disk tests, where its BIOS Disk Seek and large-record DOS File Access scores are surpassed by all of the competition, an anomaly easily corrected by replacing the machine's 32-millisecond drive with a faster model. The Wells American CompuStar 286 makes the biggest impression on the basis of test results alone, but the computer's unique design makes it better suited to some uses than others.

Relative Times
(8-MHz IBM PC AT = 100)



(CONTINUES)

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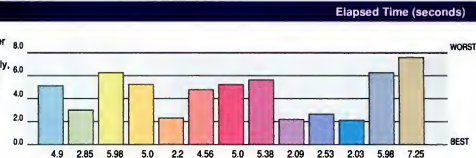


BENCHMARK TESTS: 20-MHz 286-BASED PCs (continued)

VIDEO BENCHMARK TESTS

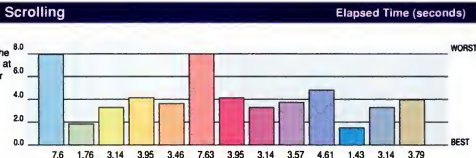
Direct to Screen

The Direct to Screen benchmark test indicates the speed of the video adapter memory. Good scores indicate that information can get to the screen quickly, particularly for programs that avoid the computer's BIOS and go directly to the screen.



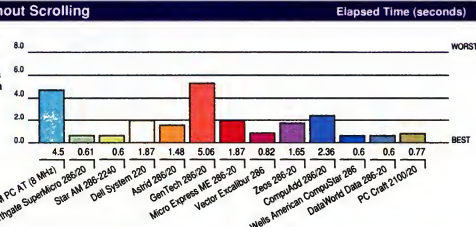
Video BIOS Routine with Scrolling

The Video BIOS Routine with Scrolling benchmark test measures how fast the video adapter can scroll the screen, moving the display up one line at a time. Good performance is helpful for scrolling through word processing or spreadsheet files.



Video BIOS Routine Without Scrolling

The Video BIOS Routine Without Scrolling benchmark test measures how quickly the BIOS on the video adapter writes text data to the screen. Fast video writing helps with programs that show full or partial screens of data without scrolling the screen.

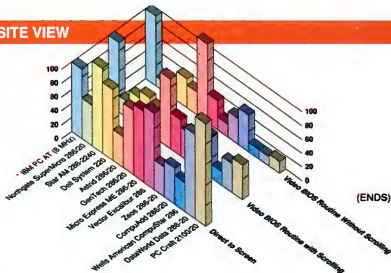


* This product was not reviewed, but we are reporting its test results for comparison.



VIDEO BENCHMARK TESTS: COMPOSITE VIEW

Relative Times
(8-MHz IBM PC AT = 100)



(ENDS)

COMPUTERS

20-MHz 286 PCs



FACT FILE

EDITOR'S CHOICE

Dell System 220

Dell Computer Corp., 9505 Arboretum Blvd., Austin, TX 78759; (800) 426-5150
List Price: With 1MB RAM, 1.44MB 3½-inch floppy disk drive, monochrome VGA monitor, \$2,295; with 40MB hard disk, \$2,899; with VGA monitor, \$3,299; with 100MB hard disk, \$4,099.
In Short: It's a top-quality machine in all categories, from design to construction. You'll pay for what you get, but if the limited expansion possibilities don't bother you, you can't do much better than buying the Dell System 220.

CIRCLE 399 ON READER SERVICE CARD

does not use the term, the 220 shadows the normal system BIOS and video BIOS, either of which can be defeated through the system setup program.

Standard equipment includes a single high-density 3½-inch Sony floppy disk. The evaluation system was equipped with a 100MB Conner 3½-inch hard disk that supports 1:1 interleaving. A 40MB drive is also available.

The compact size of the System 220 limits the choice of both floppy and hard disks and precludes the use of an internal tape backup system, including models made to fit a 3½-form factor.

Power is provided by a supply that Dell specs at 85 watts, although the evaluation system held a 100-watt Senstron unit. Its three power connectors supply what you need for a fully configured system. You won't need more, so you don't get more. The CMOS memory of the 220 and its clock are kept alive when the system is switched off by a rechargeable nickel-cadmium battery on the system board that is about the size of a stack of four quarters.

One place where the System 220 backs away from the PS/2 influence is setup—its system board gives you a wealth of setup options in the guise of a veritable forest of jumpers. In addition to the three that control memory allocation, one defeats system board hard disk support, one disables the hard disk interrupt, one allows assignment of interrupts to the system board serial ports, one defeats the on-board VGA, one selects monochrome or color as the display default, and one defeats the on-board floppy disk control circuitry.

OTHER FEATURES

Dell includes a Key Tronic keyboard with the 220 that follows the Enhanced layout. Unfortunately, it's the model with the Spacebar that requires markedly higher actuation pressure than the rest of the keys. Dell systems are also normally sold with monitors, which wear a proprietary label. The color VGA monitor with the evaluation system, a \$300 upgrade, functionally duplicated IBM's 14-inch 8513 display.

For new users the best part of the Dell system is its excellent documentation, almost good enough to teach your dog to use the system. Dell includes DOS 3.3 with the System 220 and, optionally, will supply its own version of OS/2 for \$325. Should problems arise, the 1-year warranty is backed by on-site service.

Of the PCs evaluated here, the Dell System 220 is the most professionally designed and made. If its small footprint and integrated support are more of a priority to you than expandability or cost, the System 220 is an excellent choice.

GENTECH CORP.

GenTech 286/20

The electronic equivalent of Minnesota Fats, the GenTech 286/20 is a real hustler. In its AT-style case, it looks like another bloated and overweight PC on your desktop, but boot it up and your programs will be whisked along at three times AT performance, thanks to its 20-MHz Harris 80C286 microprocessor. Unlike the Fats, however, the GenTech 286/20 isn't out to take your cash. Its base price, sans hard disk and display, makes it the most affordable machine in this review, a mere \$1,199. Add a 60MB hard disk and monochrome display, and it squeaks in just below the \$2,000-barrier.

THREE PERFORMANCE OPTIONS

The bargain price doesn't buy you a computer that's slight on speed. System memory choices give you three performance options, depending on what you're willing to pay for DRAM chips. With 80-nanosecond chips like those in the evaluation unit, you can choose either one wait state or page-interleaved operation. Spring for the premium prices of 70-ns. chips, and the GenTech 286/20 will race along without the waits (at least according to GenTech). The evaluation unit performed near the bottom of the pack in most of our benchmark tests, but even with those results it's one of the fastest 286s around.



FACT FILE

GenTech 286/20

GenTech Corp., 205 Hallene Rd., Warwick, RI 02886; (401) 732-5588

List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, \$1,199; with monochrome monitor, 60MB hard disk, DOS 3.3, \$1,389; with VGA monitor, \$2,409

In Short: The GenTech 286/20 is a respectably fast 286 for those on a budget. One of the slower machines in this roundup, the GenTech is solidly constructed, although it currently lacks FCC approval.

CIRCLE 401 ON READER SERVICE CARD

SYSTEM BOARD

The Dell system board is based upon a Chips and Technologies chip set, fully rated for 20 MHz. (In fact, one bears a 38-MHz rating—a portent of things to come?) The microprocessor is a Harris 80C286 operating at its rated 20-MHz speed. Should the need arise, the system can be slowed to an 8-MHz rate using its system setup program (available by pressing Ctrl-Alt-Enter), which requires rebooting the computer. Microprocessor speed cannot be changed on the fly. A socket for adding an 8-MHz 80287 numeric coprocessor is readily accessible in the left-front corner of the system board.

All system board memory resides in eight SIMM sockets. As standard equipment, four are filled with 256-kilobit SIMMs to yield 1MB, split by default 640K for DOS, 384K extended. The System 220 also supports 1-megabit SIMMs, allowing a total on-board capacity of 8MB. SIMMs must be installed in banks of four, all those within the same bank having the same capacity. System board capacities of 1, 2, 4, 5, and 8MB are therefore possible. All SIMMs must be rated at 80 nanoseconds, and the system achieves near-zero-wait-state operation thanks to the interleaving of memory pages.

Memory can be added in the 16-bit expansion slots up to a system addressing limit of 16MB, but expansion board RAM will operate much slower, at the fixed 8-MHz rate of the bus. Jumpers on the system board allow you to move the division to 256K for DOS to allow more room for EEMS and EMS 4.0 bank-switching.

STANDARD CONFIGURATION

The BIOS of the Dell System 220 is Phoenix's Version 3.10, and the system setup procedures are built into it. Although Dell

COMPUTERS
20-MHz 286 PCs

Memory is configured in four banks, each of which comprises four 4 by 256-kilobit chips and two 1 by 256-kilobit chips for parity checking. Interleaved operation requires that two or four banks be filled. The evaluation machine had its full quota of 2MB on the system board, with the extra megabyte priced at \$400.

SYSTEM BOARD

The system board that does these tricks is a JCIS Corp. JCAT 286 model 5288. As with most of the other computers in this review, it's primarily based on the Chips and Technologies NEAT chip set—but with all parts fully rated for 20 MHz. The Phoenix BIOS used by the system allows you to configure the chief features of the NEAT chips—including full EMS 4.0 support and shadow RAM in 16K blocks—without toggling switches or spinning a disk. The EMM.SYS driver necessary for bringing EMS to life is included with the GenTech 286/20—the only software accompanying it.

When the need arises, the microprocessor can be slowed to 8 MHz by pressing a front-panel push button (not functional in the evaluation machine) or pressing Ctrl-Alt-Minus at the keyboard. To go the other direction and get added performance, an 80287 numeric coprocessor can be plugged into a readily accessible socket. The chip is driven by a 10-MHz clock.

Bus speed is fixed at an asynchronous 8 MHz, derived by a separate crystal oscillator. This signal serves the eight expansion slots, two of which accept only 8-bit boards; the rest 16-bit. One 8-bit connector shares its slot with another connector for a proprietary 16-bit memory bus that operates at full microprocessor speed. All slots are full-length and AT height except for one 8-bit-only slot, which runs so close to the drive bays that it's best considered a short slot.

EXPANSION SLOTS

Three slots were filled in the evaluation machine. Two of the boards used 8-bit interfaces (but not 8-bit slots): a Paradise Systems VGA Plus video adapter and a standard AT-type serial/parallel card with a second serial and parallel port cabled out to the back panel over an adjacent slot. The specs list only one of each port type as standard. The Western Digital WD1003-RA2 combined 16-bit hard-and-floppy disk controller filled another slot.

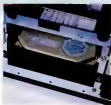
In the evaluation machine this controller drove a standard-equipment Newtronic



high-density 5¼-inch floppy disk drive and a Seagate ST-277R hard disk (a \$620 option) that produced 65MB of storage, thanks to the RLL data coding produced by the controller. The drive barely made AT standards, however, delivering a 41-millisecond average access time in testing.

All drives are mounted in standard AT fashion, using AT mounting rails both in the right-hand stack of three half-height drive bays and the internal full-height hard disk bay (which also has guide rails for two half-height devices). Besides the expected hard disk activity and power indicators on the control panel, a turbo indicator, reset switch, and turbo switch are also present on this unit. The cylindrical key lock secures the tops of the case and locks the keyboard electrically.

The GenTech 286/20 offers an almost unbeatable price: \$2,409 for a machine with 1MB RAM, 60MB hard disk, and VGA monitor. And every component in the full 20-MHz system speed. Still, you may want to do a little parts-swapping: the 286/20's Seagate ST-277R hard disk doesn't meet the standard AT specification of a 40-millisecond average access time.



OTHER FEATURES

The 200-watt power supply offers four drive power connectors and operates from either 110-volt or 220-volt line current, selectable through a rear-panel slide switch. A rechargeable nickel-cadmium battery soldered to the system board supplies power for the clock/calendar and CMOS setup memory.

The chassis is uncluttered; what workmanship it required is very good. The chassis is made from medium-weight steel but is still prone to flexure when the cover is removed from the case. While the evaluation system bore no FCC rating (Class A is pending, according to GenTech), it carried the standard 1-year warranty and a 30-day money-back guarantee.

The evaluation system was accompanied by a Taiwan-made Chicony Electronics keyboard that duplicates the Enhanced keyboard down to its tactile feedback and keyclick. The \$420 optional VGA display system included an Imtech 1453Q 14-inch color VGA-only display in addition to the Paradise display adapter.

If every last dollar of your computer budget is critical and you still want top speed, consider the GenTech 286/20. It may not be the classiest piece of hardware on the market, but it delivers hustle without a hassle.

The chassis of
the GenTech 286/20
is made from medium-
weight steel but
is still prone
to flexure when
the cover is removed
from the case.

Systems of Choice

QUALITY AT AN AFFORDABLE PRICE



"The Portacom II is a value leader with fast memory, a fast drive controller and a terrific keyboard...Haven't you cheap powerful alternative...outperformed the other 286's" (Oct. 11, 1988)



"The Datavord 286 (12 MHz) AT compatible is the fastest machine of the nine tested in the review" (Sep. 27, 1988)



"The Datavord offers a 16-bit video system with a top-quality NEC Multisync monitor and an exceptionally fast disk drive controller for an impressive combination of value and performance...from a vendor with an increasing reputation for quality" (Feb. 28, 1989), 16 MHz system.



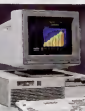
PORTACOMP II

STANDARD CONFIGURATION

- Intel 80286-12 microprocessor
- 812K base memory, expandable to 4MB on board
- Socket for Intel 80287-10 numeric coprocessor
- Two available 18-bit expansion slots
- Superbowl backlit LCD 9" x 6" display, 640x400 resolution in CGA double-scan
- Dual hard/floppy controller
- 1.44MB 3.5" internal AND 1.2MB 5.25" external diskette drive
- 20MB, 48me hard drive
- Enhanced 102-key "click" touch keyboard
- 1 parallel and 2 serial ports
- 8-pin external monitor output port
- 150W power supply

AVAILABLE OPTIONS

- EGA gas plasma display, or mini-tower case
- Memory expansion to 640K, 1MB, 2MB, or 4MB
- 40-, 150MB hard drives with MFM, RLL, ESDI, or SCSI Interface
- Numeric coprocessor 80287
- 2400B Internal or external modem
- Carrying case



DATA 286-12

STANDARD CONFIGURATION

- Intel 80286-12 microprocessor
- 812K base memory, expandable to 4MB on board
- Socket for Intel 80287 numeric coprocessor
- 4 18-bit and 2 8-bit expansion slots
- Dual hard/floppy controller
- 1.2MB 5.25" floppy drive
- Enhanced 101-key "click" touch keyboard
- 1 parallel and 2 serial ports
- 200W power supply

AVAILABLE OPTIONS

- Full-size vertical case or mini-tower case
- 32K static-RAM cache (with Auster cache controller) for 20MHz
- RAM upgrade to 2-, 4-, 8-, 12-, or 16-MB
- Numeric coprocessor 80287
- 40MB - 150MB tape backup drive
- Available in standard monochrome (720x348, amber), standard VGA (640x480, color) or extended VGA (800x600 up to 1024x768, color)
- 1.44MB 3.5" diskette drive

Drive Controller	Standard	Standard Internal	Standard External
40MB, 5.25"	\$1,700	\$1,700	\$1,700
11.1 MB, 5.25"	\$1,700	\$1,700	\$1,700
11.1 MB, 5.25"	\$1,700	\$1,700	\$1,700
11.1 MB, 5.25"	\$1,700	\$1,700	\$1,700
11.1 MB, 5.25"	\$1,700	\$1,700	\$1,700
11.1 MB, 5.25"	\$1,700	\$1,700	\$1,700
11.1 MB, 5.25"	\$1,700	\$1,700	\$1,700
11.1 MB, 5.25"	\$1,700	\$1,700	\$1,700
11.1 MB, 5.25"	\$1,700	\$1,700	\$1,700
11.1 MB, 5.25"	\$1,700	\$1,700	\$1,700



DATA 386-16-/20

STANDARD CONFIGURATION

- Intel 80386-16 or -20 microprocessor
- 1MB base RAM, expandable to 16MB or 32-bit memory
- LM EMS 4.0 driver supplied
- Socket for Intel 80387 numeric coprocessor
- 1 32-bit, 5 16-bit and 2 8-bit slots
- Dual hard/floppy controller
- 1.2MB 5.25" floppy drive
- Enhanced 101-key "click" touch keyboard
- 1 parallel and 2 serial ports
- 230W power supply

AVAILABLE OPTIONS

- Full-size vertical case or mini-tower case
- 32K static-RAM cache (with Auster cache controller) for 20MHz
- RAM upgrade to 2-, 4-, 8-, 12-, or 16-MB
- Numeric coprocessor 80387
- 40MB - 150MB tape backup drive
- Available in standard monochrome (720x348, amber), standard VGA (640x480, color) or extended VGA (800x600 up to 1024x768, color)
- 1.44MB 3.5" diskette drive
- Waptek socket on 20 MHz

Drive Controller	Standard	Standard Internal	Standard External
40MB, 5.25"	\$2,300	\$2,300	\$2,300
11.1 MB, 5.25"	\$2,300	\$2,300	\$2,300
11.1 MB, 5.25"	\$2,300	\$2,300	\$2,300
11.1 MB, 5.25"	\$2,300	\$2,300	\$2,300
11.1 MB, 5.25"	\$2,300	\$2,300	\$2,300
11.1 MB, 5.25"	\$2,300	\$2,300	\$2,300
11.1 MB, 5.25"	\$2,300	\$2,300	\$2,300
11.1 MB, 5.25"	\$2,300	\$2,300	\$2,300
11.1 MB, 5.25"	\$2,300	\$2,300	\$2,300
11.1 MB, 5.25"	\$2,300	\$2,300	\$2,300



DATA 386-25

STANDARD CONFIGURATION

- Intel 80386-25 microprocessor
- 1MB base memory RAM, expandable to 16MB or 32-bit memory
- LM EMS 4.0 driver supplied
- Socket for Intel 80387-25 or Waptek numeric coprocessor. Optional adapter will accommodate both 80387 and Waptek
- 1 32-bit, 5 16-bit and 2 8-bit slots
- Dual hard/floppy controller
- 1.2MB 5.25" floppy drive
- Enhanced 101-key "click" touch keyboard
- 1 parallel and 2 serial ports
- 230W power supply

AVAILABLE OPTIONS

- Full-size vertical case or mini-tower case
- RAM upgrade to 2-, 4-, 8-, 12-, or 16-MB
- Numeric coprocessors 80387 or Waptek
- 40MB to 300MB hard drives with MFM, RLL, ESDI, or SCSI interface
- 40MB-150MB tape backup drive
- Available in standard monochrome (720x348, amber), standard VGA (640x480, color) or extended VGA (800x600 up to 1024x768, color)
- 1.44MB 3.5" diskette drive

Drive Controller	Standard	Standard Internal	Standard External
40MB, 5.25"	\$2,300	\$2,300	\$2,300
11.1 MB, 5.25"	\$2,300	\$2,300	\$2,300
11.1 MB, 5.25"	\$2,300	\$2,300	\$2,300
11.1 MB, 5.25"	\$2,300	\$2,300	\$2,300
11.1 MB, 5.25"	\$2,300	\$2,300	\$2,300
11.1 MB, 5.25"	\$2,300	\$2,300	\$2,300
11.1 MB, 5.25"	\$2,300	\$2,300	\$2,300
11.1 MB, 5.25"	\$2,300	\$2,300	\$2,300
11.1 MB, 5.25"	\$2,300	\$2,300	\$2,300
11.1 MB, 5.25"	\$2,300	\$2,300	\$2,300

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**PC
MAGAZINE**

tirely. As for speed, Fastback Plus is ready for the next backup diskette before you finish labeling the one you just removed.

Fastback Plus takes the guesswork out of the backup process by showing subdirectories and their contents on a split screen. Files can be selected for backup by name, date range, directory, or archive bit, or they can be marked individually. A particularly nice feature is Fastback's ability to estimate the

Fastback Plus

Fastback—a program that backs up your hard disk—is fast, and it is reliable. Now Fifth Generation has improved it. The company fixed the manuals and then put in help files that make the manuals nearly superfluous. Then it added data compression to save disk space and a utility that estimates how many floppy disks and how long the job will take.

With this program, we've copied 38 megabytes of data from one machine to another in 28 minutes (which included formatting the disks). Fast-

back Plus

Fastback Plus 2.01: No More Backup Excuses

BY EDWARD MENDELSON

The best backup program is the one that gives you the fewest excuses not to use it. Fifth Generation Systems' \$189 Fastback Plus, Version 2.01, pulls out the rug from under almost every antbackup excuse you can imagine.

Do your backups take too much time? Fastback Plus backs up 10MB of a real hard disk to a single drive in 4 minutes yourself—no help by



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Anything Less.**

PC WORLD

EXECUTIVE SUMMARY

Fastback Plus 2.0 Hard disk backup utility



Fastback Plus has state-of-the-art backup features and such extras as a keyboard macro recorder and menu-selectable voice and advanced interfaces. The program is fast.

	Speed	Backup selectivity	Security	Floppy disk handling	Overall value
	5	5	5	5	5

Fastback Plus gets more backing than any other backup program. From reviewers, users and corporate MIS. In fact, it's now the standard by which all other backups are judged.

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**Fifth
Generation
SYSTEMS, INC.**

MICRO EXPRESS, INC.

ME 286-20

If there can be such a thing as a generic 20-MHz 80286-based computer, Micro Express's ME 286-20 is a top candidate for the dubious laurels. Though it may not earn a high grade for originality, the \$1,899 system (with 2MB RAM and 40MB hard disk) does score well when it comes to functionality.

Workmanship on the ME 286-20 is good—the system is cleanly laid out inside—and construction is sturdy enough; the case doesn't deform when lifted by one corner after the cover has been removed. It bears an FCC Class B rating.

In design, the ME 286-20 is a straight AT compatible with its only improvement on the norm being front-panel access for the bottom of the three right-hand 5¼-inch disk bays. Inside resides the expected full-height hard disk bay, and all drives mount with standard AT-size rails.

The front control panel shows the most modest of innovations—the addition of turbo and reset switches and a turbo indicator to complement the power and hard disk activity LEDs. The cylindrical lock controls only the keyboard.

At rear, the only variance from other AT clones is that the recessed area for expansion slot retaining brackets has been expanded to also hold two blanked cutouts for 25-pin D-shell connectors and two for 9-pin D-shells. Most other systems just put these holes in the middle of the rear panel.

CHIPS

The brains of the ME 286-20 is an Informtech 286/Supra system board, which is basically an implementation of the Chips and Technologies NEAT chip set. In Micro Express clothing, the board includes both shadow RAM and built-in hardware support for EMS 4.0, controlled through system board jumpers. EMS software is the only software included with the system.

The chip set in the evaluation machine was rated at only 16 MHz, even though the microprocessor was a full-speed 20-MHz Harris 80286. According to Micro Express, all systems shipped since February have been equipped with 20-MHz parts.

System board DIP switches allow installing your choice of either an 8-, 10-, or 12-MHz 80287 numeric coprocessor in a waiting socket. The evaluation machine was equipped with an 80287-10. System

board jumpers limit the maximum operating speed of the microprocessor to either 20, 16, or 12 MHz. The system clock can also be reduced to half speed by pressing the front-panel turbo push button or pressing Ctrl-Alt-1 on the keyboard. To indicate slow operation, the default cursor transforms itself from an underline to a flashing block.

PERFORMANCE

Other performance options include setting one of two speeds for the keyboard controller, 6 or 12 MHz, changing the bus speed to either 8 or 12 MHz (according to the company), and electing to impose memory wait states.

Actually changing the bus speed jumper made no apparent difference in hard disk data transfers but substantially slowed video performance: BIOS-mediated video routines ran as slow as half speed. When measured, the bus speed actually proved to be 10 MHz with either jumper setting.

Because the internal hard disk bay covers the master clock, bus speed, and keyboard speed selection jumpers, you'll have to remove either the drive or the system board to alter their settings—an effort not worth the time required.

The system board accommodates either 256-kilobit or 1-megabit memory chips in its 36 staggered sockets. Using the smaller chips, up to 2MB can be installed on the system board; 8MB with the bigger chips. In the evaluation system, all chips were of



FACT FILE

ME 286-20

Micro Express Inc., 2114 S. Grand Ave., Santa Ana, CA 92705; (714) 662-1973

List Price: With 2MB RAM, 1.2MB 5¼-inch or 1.44MB 3½-inch floppy disk drive, 40MB hard disk, \$1,899; with monochrome monitor, DOS 3.3, \$2,118; with 80MB hard disk, \$2,418; with VGA monitor, \$3,018.

In Short: It's the plainest white-bread fast 286 around, but it's speedy and solid enough to suit basic needs, particularly budgetary ones.

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the 1Mb capacity. Rated at 100 nanoseconds, the page/interleaved memory with the no-wait-states setting actually delivers the performance level of about 0.7 wait states, identical to the majority of machines in this review.

Although the 200-watt power supply operates from either 110 or 220 volts, you'll have to open the case to find the selector switch, which is mounted inside just above the big red power paddle. The case contains a switched outlet for a display and four drive power connectors (two used in the evaluation system). In the evaluation system, power for the clock and CMOS setup memory was derived from a Rayovac 844 alkaline battery that was attached to the top of the power supply with Velcro.

DRIVES

In the evaluation system, the standard-equipment 5¼-inch high-density floppy disk drive proved to be a TEAC FD-



The ME 286-20 from Micro Express isn't the machine to buy if innovation excites you; it's just about as generic an AT clone as they come. Still, simplicity comes at a low price: the system sells for \$3,018 with 2MB RAM, 80MB hard disk, and VGA monitor.

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55GFR. The optional hard disk was a Magnetic Peripherals (Control Data) 94166-182 that delivered 147MB of formatted capacity with an average access time of 16 milliseconds. The \$1,300 ESDI drive was controlled by a Data Technology model 9280 floppy/hard disk controller in one of the system's six 16-bit expansion slots.

A second 16-bit slot was filled with an optional Paradise VGA 16-Plus video controller, matched with a NEC MultiSync II display. (The VGA monitor and adapter adds \$750 to the base price of the ME 286-20.) One 8-bit slot was filled with an I/O card that yields the standard equipment one parallel port with female 25-pin D-shell connector and a serial port using a male 9-pin D-shell. An eighth slot serves either as an 8-bit expansion slot or for proprietary 16-bit memory at full system clock speed.

Included with the base system is a Maxi-Switch model 218603XC keyboard, which follows the Enhanced design. The system warranty extends for 15 months and includes mail-in or carry-in service covering both parts and labor. The Award BIOS features built-in setup procedures.

The ME 286-20 is a competent but not exemplary computer. If your needs call for a fast 286 that doesn't pull any punches or add any frills, this computer will serve them well.

NORTHGATE COMPUTER SYSTEMS INC.

Northgate SuperMicro 286/20

Northgate wants to change some of the ideas you have about high-performance computers. According to the Northgate philosophy, for instance, the performance panacea of shadow RAM is hot air rather than hot stuff. And, true to promise, the SuperMicro 286/20 brings these renegade viewpoints to life with surprising results.

Without shadowing, the SuperMicro 286/20 delivers better video performance than do many systems with it. Although the 286/20 lags on some chores because of its enforced one-wait-state operation, it handles integer addition and multiplication as fast as do near-zero-wait-state machines. And the price is competitive: a system with Hercules-compatible monochrome display, 65MB hard disk, DOS



Northgate offers its SuperMicro 286/20 for \$3,024 with 1MB RAM, 65MB hard disk, and VGA monitor and delivers top quality for the price. To eliminate worries about battery replacement, for instance, the CMOS setup memory and time-of-day clock built into the machine are a single integrated module with an estimated lifespan of 10 years.



4.01, and Super PC-Kwik disk caching software lists at \$2,399.

Physically patterned almost exactly after the original AT, the SuperMicro 286/20 is the same size and shape; the only departure is the three openings for disk drives on the right-hand side of the box.

A more-important difference is the three connectors poking out of the five spaces on the rear panel. Two are 9-pin male D-shell serial ports and one is a 25-pin female parallel port. The circuitry for these ports is built into the Northgate system board as standard equipment. Monochrome systems benefit from a second parallel port on the display adapter.

The chassis itself is built from a somewhat heavier-gauge steel than most AT clones, and the result is a physically sturdier computer. Drives mount with a proprietary rail system similar to that of the AT, but the rails are slimmer and made of steel. The internal full-height drive bay is configured to handle two half-height devices.

SYSTEM BOARD

The heart of the system board is a Harris 80C286 processor rated and operating at a full 20 MHz. A front-panel switch cuts the speed down to 8 MHz for software compatibility.

Northgate sees the ubiquitous Chips and Technologies chip set as being almost the devil's work. Consequently, the SuperMicro 286/20 is built from discrete circuits and two VLSI Application-Specific Integrated Circuits (ASICs) that work together to achieve performance enhancements. For other companies, the downside

of this design is the lack of the chip set's shadow RAM, but Northgate considers that an advantage.

The system board reserves a socket for an 80287 numeric coprocessor with speed ratings of 7, 10, or 14 MHz accommodated by jumper settings. Expansion slots operate at 8 MHz.

Special double-pinned sockets accommodate either 256-kilobit or 1-megabit memory chips in one or two 18-chip banks, endowing the SuperMicro 286/20 with up to 4MB on the system board. One megabyte is standard. A proprietary memory expansion connector allows the addition of even more RAM running at full microprocessor speed, up to the system's 16MB addressing capacity. All chips in



FACT FILE

Northgate SuperMicro 286/20

Northgate Computer Systems Inc., 13895 Industrial Park Blvd., Plymouth, MN 55441; (800) 548-1993

List Price: With 1MB RAM, 1.2MB 5¼-inch and 1.44MB 3½-inch floppy disk drives, 65MB hard disk, monochrome monitor, DOS 4.01, \$2,399; with VGA monitor, \$3,024; with 155MB hard disk, \$3,924.

In Short: Northgate answers the need for speed with innovative design and packs it into a solid, traditional AT-style case. Fast video, superior support, and a fair price combine to make this machine a prime choice.

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the evaluation machine were rated at 80 nanoseconds—not up to the task of complete zero-wait-state operation—hence the unwarying one wait state.

Because shadow RAM is lacking, more of the memory of the SuperMicro 286/20 is available for other uses. The 2MB in the evaluation machine were configured with 640K for DOS, 1,408K in the extended addressing area. Northgate supplies a disk caching program to put the extended memory to work.

EXPANSION SLOTS

Only six expansion slots are available: one 8-bit, four 16-bit, and the proprietary memory slot (which can also serve as an 8-bit expansion slot). There doesn't seem to be any reason for the shortage of slots; the case of the SuperMicro 286/20 is designed to accommodate eight slots (eight retaining brackets are available), and adequate room is available inside for the full complement of slots.

Two 16-bit slots were filled in the evaluation unit: one with a 16-bit Video Seven VGA adapter, the other with an Adaptec ACB-2232 floppy/hard disk controller upgrade. The standard controller is an Adaptec 2372B.

Mass storage in the evaluation system included the two standard-equipment high-density Newtronics floppy disk drives, one 1.2MB 5¼-inch and one 1.44MB 3½-inch. An optional fast (18-millisecond average access time) ESDI Miniscribe 3180 hard disk added 155MB of mass storage to the system, an upgrade that costs \$695.

The system clock, CMOS setup memory, and lithium power (good for 10 years) are combined into a single module that's soldered to the system board. The 220-watt Power Tronic power supply has four drive connectors and accommodates both 115- and 230-volt operation, selected with a rear-panel DIP switch, at 50 or 60 Hz. A switched power jack is available for connecting a display.

CONSTRUCTION

Overall construction of the SuperMicro 286/20 is very good, although lead dress inside the machine is somewhat sloppy. On the other hand, the documentation is terrific, designed to ease new users into PC-dom while including adequate reference material for more-experienced users. In addition, Northgate supplies an on-line user's guide with hypertext-like reference abilities and offers a 1-year warranty

backed by an overnight replacement program and on-site service (from Sorbus for business users only).

For writers and others who depend on keystrokes for their livelihood, the Northgate Omni Key/102 keyboard will be a blessing. A 102-key cross between IBM's AT and Enhanced-style keyboard designs (left-hand function keys, large Enter key, but separate cursor and numeric/cursor keypad), the Omni Key has the same solid tactile feel and click of an IBM keyboard.

The standard-equipment display is a 14-inch flat-screen amber digital monitor. The evaluation system included an optional Intec 1455 multiscanning color 14-inch VGA display, a \$745 upgrade (including adapter).

Although the SuperMicro 286/20 comes up two slots shy and has one wait state too many, it vindicates itself with its wealth of standard equipment, making it a good buy in this performance category. And it may just change your mind about the need for shadow RAM.

PC CRAFT INC. PC Craft 2100/20

Craftsmen do things that ordinary mortals only aspire to, making objects with enviable precision and attention to detail. Despite its name, however, PC Craft falls short in this arena. Overall, the 2100/20 is an excellent performer in an ordinary AT case, but a myriad of rough edges detract from its desirability. Moreover, the \$2,055 base price is somewhat high, considering that neither display nor hard disk is included.

Perhaps the most worrisome detail is the rating of the components. Although the microprocessor, a Harris 80C286, was rated for the full 20-MHz clock speed of the system, the highly integrated Chips and Technologies NEAT chip set was not; it was labeled only for 16-MHz operation. The chip set and the 2100/20 do support defeatable shadow RAM and EMS 4.0 with system board memory using the driver software included with the machine.

System board jumpers allow selection of the top operating speed of the microprocessor at 20, 16, or 12 MHz. The system clock can also be cut to half speed us-



FACT FILE

PC Craft 2100/20

PC Craft Inc., 5330 Jamie Ave., Lahabra, CA 90026; (800) 733-6666
List Price: With 1MB RAM, 1.2MB 5¼-inch or 1.44MB 3½-inch floppy disk drive, DOS 3.3, \$2,055; with monochrome monitor, 65MB hard disk, \$2,965; with VGA monitor, \$3,560.
In Short: Nothing to write home about, the PC Craft 2100/20 sports basic design and construction and a middle-of-the-road price. The overall quality is shortchanged by 16-MHz parts and a Class A FCC rating.

CIRCLE 403 ON READER SERVICE CARD

ing a three-key sequence, Ctrl-Alt-1 (for low speed) or Ctrl-Alt-2 (for high). Unfortunately, the documentation does not coincide well with reality. Not only are the actuating keys reversed, but the system does not follow the documented beep code. However, low speed was properly indicated by an enlarged (block) cursor and high by the "turbo" indicator on the control panel. Choosing low speed using the control panel "turbo" switch overrides software high-speed selection.

SYSTEM BOARD

The Informtech 286/Supra system board also features a socket for an 80287 coprocessor. The speed of the coprocessor is selectable using a DIP switch for 6, 8, 10, or 12 MHz. You can also set one of two speeds for the keyboard controller: 6 or 12 MHz. This feature is presently a dubious virtue since the biggest limits on keyboard performance result from BIOS routines. The PC Craft BIOS bears an Award copyright and includes built-in setup procedures.

Up to 2MB can be installed on the system board in 512K banks, each bank composed of four 4 by 256-kilobit chips and two 1 by 256-kilobit parity chips, all rated at 80 nanoseconds. According to the documentation, memory can be configured for zero wait states with interleaved operation. Setup options allow a user-defined number of wait states, defeating interleave, as well as other options to slow down the performance of the system.

The master clock, bus speed, and keyboard speed selection jumpers are all hidden under the hard disk bay. You can't change them without removing the system board or hard disk. In any case, you shouldn't be tempted to fiddle with these. Changing the clock speed will only hurt system performance; the keyboard speed

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...won't do much at all. And the jumper for changing the bus speed proved ineffectual.

SLOTS

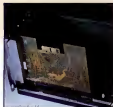
PC Craft's claim that the 2100/20 contains nine slots is optimistic: the 16-bit memory slot shares space with one of the three that offer an 8-bit interface. The slot total is brought to eight with five 16-bit AT-style slots. Bus speed for the 8- and 16-bit slots can be selected with a system board jumper between 8 and 12 MHz.

Three slots were filled in the evaluation machine. A optional Renaissance GRX VGA adapter and optional generic serial/parallel card each filled an 8-bit slot. The latter will support a second serial port with the addition of a second 16450 UART chip and cable. Cutouts on the rear of the chassis will accommodate any connectors you choose: there's space for two 9-pin and three 25-pin D-shells. An Adaptec ACB-2372B RLL floppy/hard disk controller filled a 16-bit slot, an upgrade over the base NCL5425 MFM controller.

CHASSIS

The PC Craft chassis has the same drive mounting options as an AT, though all three right-hand half-height drive bays have front-panel access. The internal full-height bay also features supports for two half-height drives. Drives mount with standard AT rails and hardware. The standard-equipment high-density 5¼-inch floppy disk drive was a TEAC FD-55GR in the evaluation machine. The optional (\$795) Mitsubishi MR535-U00 hard disk

The PC Craft 2100/20 sells for \$3,560 with 1MB RAM, 65MB hard disk, and VGA monitor. You can stretch its eight slots to nine by installing an 8-bit short card in the slot area shared by its high-speed (20-MHz) memory expansion connector. Inserting a proprietary expansion board in a special 16-bit connector allows system memory to be expanded from 2MB to 16MB.



in the internal bay yielded 64MB using RLL coding.

Electrifying everything is a 200-watt power supply that operates from either 110 or 220 volts, selectable by a rear-panel slide switch. The power supply has an outlet for a display and four drive power connectors (two used in the evaluation system). The 2100/20 came equipped with an alkaline battery to power its CMOS memory, but a system board jumper also permits lithium cells to be used for this purpose.

Construction and styling of the 2100/20 closely conform to standard AT practice; you won't find any fancy tricks lurking underneath this PC's cover. While the sheet metal is reasonably sturdy and the workmanship about average for the FCC industry, the 2100/20 earns only an FCC Class A rating.

OTHER FEATURES

The keyboard that came with the 2100/20 was a Maxi-Switch Model 218603XC, which conformed to the 101-key Enhanced design. The evaluation system also had a Relisys RE9513 VGA display.

Technical documentation of the system board is extensive in the manual, which also has introductory text for new users (on the level of "This is a keyboard . . .").



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PC Magazine, May 30, 1989

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An EMS driver, DOS 3.3, and BASIC are all included in the price of the base system, as is a 1-year warranty with 4 months of on-site service followed by carry-in maintenance.

Little distinguishes the PC Craft 2100/20. It's just as good—and bad—as other systems using the Infomtech system board. Until the speed rating of its components matches its operating speed, it's a chancy machine to buy.

STAR INDUSTRIES

Star AM 286-2240

The Star AM 286-2240 proudly wears its made-in-the-USA label and boasts its own custom-tooled case—constructed and painted in Arizona. In fact, the American-made aspects of the AM 286-2240 are its best and most innovative features. But the \$1,814 machine (without hard disk or display) also points out how impossible it is to make a truly all-American computer. The AM 286-2240 is more like an effort of the United Nations than the United States.

The 200-watt Astec power supply originated in Malaysia, bringing from that peninsular nation five drive power connectors (thanks to a couple of extras spliced in midwire) and 115- or 230-volt, 50- or 60-Hz operation, selectable by a rear-panel slide switch. CMOS and clock power come from a rechargeable nickel-cadmium battery soldered to the system board.

From Japan came the standard-equipment TEAC FD-55GFR 1.2MB 5¼-inch floppy disk drive and the optional 1.44MB 3½-inch drive that was tucked into the evaluation unit.

The Honeywell keyboard, which fol-

lows the 101-key Advanced layout, was assembled in Mexico. It's notable for its light touch, short travel, quiet tactile feedback, and 3-year warranty.

The TMC Research system board bears a Taiwan imprimatur, although it's primarily based on a Chips and Technologies chip set (made in Japan) with components stuffed into the board in Arizona. The semiconductors used are an all-nations festival of their own: Portugal, West Germany, Singapore, Korea, Japan, and even the U.S. are represented.

ALL-AMERICAN ELEMENTS

The real all-American elements of the AM 286-2240 are its case, its unique front control panel, and its final assembly.

The case, although custom designed and made, is nothing remarkable. It roughly follows the mini-AT format: AT height but reduced footprint—6½ by 17 by 16 inches (HWD)—with a single stack for three half-height 5¼-inch disk drives, all with front-panel access. Extending from the left side of this bay is an internal bay that (physically) supports a vertically oriented 3½-inch drive. A removable panel gives the option of front-panel access to this drive. Top choice for filling this space is the \$549 Core 40MB hard disk. In the evaluation system, hard disk capacity was boosted to 60MB through the use of a DTC 7287 RLL controller. The standard-equipment floppy/hard disk controller, a Data Technology Corp. model 7280, gets only 40MB from this disk using MFM coding.

Drives are mounted by being screwed directly into the bay. Unfortunately, re-

The novel, American-made case of the Star AM 286-2240 (\$3,044 with 1MB RAM, 60MB hard disk, and VGA monitor) boasts a multifunction control panel. The display provides diagnostics and operational indications, while the membrane switches activate dedicated functions and the keyboard lock.



moving the screws on the left side of the drives first requires removal of the 3½-inch hard disk in units so equipped.

Another Star packaging innovation will warm the hearts of interior decorators the world around: "decorator" colors can be substituted for the standard muted gray of the case if your order is large (don't get your hopes up if you're buying solo; orders of one off-custom color machine will not be honored).

CONTROL PANEL

Unique to the AM 286-2240 is the Star version of the AT control panel. As with many machines, it includes a digital LED display that normally beams the system clock speed. However, on the AM 286-2240 it also serves to indicate the day, operating speed, and drive being accessed. Instead of a key lock, the AM 286-2240 uses a small membrane-switch keypad with six switches serving double duty for either dedicated functions (reset, turbo, data) or the numeric entry of a combination to lock the system, eliminating the need for a physical key. Of course, the electronics lock only the keyboard and cannot limit removal of the system cover.

Most of the electronics of the control panel are integrated on the system's I/O card, which takes up one 8-bit expansion slot to also provide a serial port (with a male 9-pin D-shell connector) and a parallel port (female 25-pin D-shell) in the evaluation system. According to Star, normal

PC FACT FILE

Star AM 286-2240

Star Industries, 7855 E. Redfield, #10, Scottsdale, AZ 85260; (602) 483-2854
List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, mouse, \$1,814; with monochrome display, 60MB hard disk, DOS 3.3, \$2,499; with VGA monitor, \$3,044.
In Short: You can paint this baby any way you please if you buy it in quantity, and with its well-made case and respectable performance, you just might want to. Right now it lacks an FCC Class B rating, but that drawback may be only temporary.

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CIRCLE 285 ON READER SERVICE CARD

COMPUTERS

20-MHz 286 PCs

standard equipment includes two of each port type.

The other modest innovation of the AM 286-2240 chassis is convenient relocating of the power switch to the right edge of the front-panel bezel. The loudspeaker used by the AM 286-2240 appears to be an odd afterthought, hidden between the power supply and drive bays, although it is still eminently audible. As tested, the Star bore an FCC Class A certification, although the manufacturer expects to earn Class B.

Performance is delivered by a 20-MHz Harris 80C286 operating at either its full rated speed or half speed. Although Star claims interleaved memory, in PC Labs tests it turned in results consistent with one-wait-state operation, placing it among the slower machines in this review.

CHIPS

A total of 36 staggered sockets accommodates either 256-kilobit or 1-megabit chips in banks of 18. Possible memory configurations include 1MB (the standard system, all sockets filled with 256-kilobit chips), 2-, and 4MB. Beyond that, normal expansion slots are needed to extend memory since there are no further provisions for

high-speed memory. In the evaluation system, all chips were rated at 70 nanoseconds even though the system was not set up for zero-wait-state operation.

The socket for the optional 80287 numeric coprocessor is buried underneath the drive bays and requires removal of the system board should you want to plug in a chip yourself. The Phoenix BIOS of the evaluation machine includes a system setup program in its code.

The AM 286-2240 has the standard quota of expansion slots: six 16-bit and two 8-bit, all AT full-length and -height. Bus operating speed was measured at 10 MHz. Standard equipment fills three slots (8-bit I/O, 16-bit drive controller, and 8-bit monochrome graphics adapter). The standard video system in the evaluation system was upgraded by a \$150 Tecmar 8-bit OEM VGA adapter and a Colorado Memory Systems tape backup adapter that complemented the CMS DC2000 cartridge tape drive in the bottom floppy disk bay, a \$269 option.

Construction quality of the overall system is very good. The case is well made

and extremely rigid, among the sturdiest in the industry. (The same electronics are available in a full-size AT chassis). The system is covered by a 1-year parts and labor warranty.

The AM 286-2240's made-in-the-USA label may be slightly misleading, but that's no reason to be put off. The AM 286-2240 is a solidly constructed, competitive contender in its class.

VECTOR COMPUTER CORP.

Vector Excilbur 286

If looks were everything, the Vector Excilbur 286 would be a sure winner in the mini-AT class. Although squat by necessity—7 by 15 by 17 inches (HWD)—it's elegant by design. Performance, too, is near the top of the class. At \$2,095 without monitor or hard disk, it may seem that good looks cost a lot more than you expected. But as you admire the chassis, keep in mind that because the Excilbur 286 is sold through dealers rather than direct, you can expect to negotiate a better



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CIRCLE 218 ON READER SERVICE CARD

deal than the list price.

First the good news. The Excalibur 286 looks like a class act. Its shining armor is a white-beige accented by a horizontal band control panel bearing the expected emblems: rather ordinary round LED indicators for hard disk activity, turbo function, and power-on complemented by a cylindrically keyed keyboard lock and neat, round push buttons for its turbo and reset functions.

Now for the bad news. Although made of moderately heavyweight steel, the sturdy armor of the case leaks energy and has earned only an FCC Class A rating. Remove the lid, attached by four screws on the side of the case, and you'll see that the glitzy Excalibur 286 has mundane, if not worrisome, guts.

PERFORMANCE

While the Informtech 286/Supra system board delivers nearly zero-wait-state performance thanks to its interleaved memory, the principal parts that bring the system to life—the Chips and Technologies NEAT chip set—are unfortunately not rated for the job. Those in the evaluation system bore only 16-MHz markings. The Harris 80C286 microprocessor, on the other hand, was rated at the full system speed, 20 MHz.

System board jumpers reduce the top speed of the machine to either 12 or 16 MHz. Adjusting these, as well as several other jumpers, requires removing the system board because access is obscured by the drive bays.

The system can be slowed to half speed by pressing the front-panel turbo push button (which was not functional in the evaluation machine) or by pressing a combination of keys at the keyboard (which was functional). Dead turbo buttons are not uncommon on recent ATs.



If you want to add a numeric coprocessor, you can drop virtually any 80287 into the waiting socket: DIP switches allow the selection of its operating speed at 6, 8, 10, or 12 MHz.

CHIPS

Twenty-four sockets on the system board accommodate up to 2MB in 512K banks. Each bank comprises four 4 by 256-kilobit chips and two 1 by 256-kilobit parity chips, all rated at 100 nanoseconds in the evaluation system.

Hardware support for EMS 4.0 and shadow RAM are built into these circuits, both of which can be enabled or disabled through system setup. Part of the setup procedure is built into the Award BIOS. Memory interleave can be defeated and wait states added by jumper selection or through use of a setup program.

The eight expansion slots—two 8-bit, six 16-bit—operate at a measured 10 MHz. One 8-bit connector shares its slot with a proprietary high-speed 16-bit memory extension connector. All slots are full AT length and height.

In the evaluation machine, three slots were filled with a standard-equipment 8-bit I/O adapter, a 16-bit Expert EVGA Plus video adapter, and a 16-bit Adaptec ACB-2372 floppy/hard disk controller. Mass storage included a standard-equipment TEAC FD-55GFR high-density 5¼-inch floppy disk drive and an optional Microscience HH-1060 disk (throw in the disk and the system price rises to \$3,495). Thanks to the RLL controller, this drive yields 65MB of space.

The small-footprint Vector Excalibur 286 has a chassis that was trimmed partially through use of a diminutive power supply. Despite its small size, however, the chrome box delivers a full 200 watts—more than enough for any expansion options you may have in mind. The Excalibur offers 1MB RAM, 65MB hard disk, and VGA monitor for \$3,495.



OTHER FEATURES

The power supply appears tiny but bears a 200-watt rating. It operates solely from 110-volt line current and contains an outlet for a display, as well as four drive power connectors (two of which were used in the evaluation system). Continuous power for the system's CMOS memory and clock comes from a replaceable Rayovac 844 alkaline battery tucked under the power supply.

Vector included a Taiwan-made Chicony Electronics keyboard with the Excalibur 286 that conformed to the 101-key Enhanced design. It produced a clicky, tactile feel much like the IBM original, although the action has a subjectively sharper feel—different, not necessarily better or worse. The evaluation system also included a CTX 14-inch 2431P color VGA display as part of the \$500 VGA upgrade over the monochrome price.

DOS 3.3 and an EMS 4.0 driver are supplied with the system, as is a 1-year parts and labor warranty with 3 months of on-site service. Vector does not supply OS/2.

If you're not put off by parts operated beyond their ratings, the Vector Excalibur 286 will deliver quick performance in a neat package. Browbeat your local computer dealer sufficiently and it might be a good buy.



FACT FILE

Vector Excalibur 286

Vector Computer Corp., 7 Vernon St., Norwood, MA 02062; (617) 769-5318

List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, DOS 3.3, \$2,095; with monochrome monitor and 65MB hard disk, \$2,995; with VGA monitor, \$3,495

In Short: It's attractive, compact, and powerful, but watch out—the Vector Excalibur 286 is built with 16-MHz parts and earns only a Class A FCC rating.

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Sony (10 disks per box)	19.
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Go with the flow.

(Or, why the water's no longer over the dam.)

A lot's changed around here since we first began selling products for the PC in 1982. Back then, our warehouse was in a closet, orders were filled by hand, and the dam on the nearby Ashuelot River was badly in need of repair. But even though we now have a much larger warehouse, the most sophisticated order processing system in micro

mail order, and one of the most solid dams in New Hampshire, we're still country boys, girls, (and animals) at heart.

In spite of all our technological prowess, the parking lot still isn't paved, we're still surrounded by acres of forest, and our idea of a power lunch is using the microwave to heat up soup. Which means that the people you talk to when you call us tend to be a little friendlier, a little more laid back, and a little more patient than your average bear.

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WELLS AMERICAN CORP.

Wells American
CompuStar 286

If you carry an umbrella even on sunny days, the Wells American CompuStar 286 may be the computer of your dreams. The \$2,615 machine in basic 20-MHz 80286 trim is the perfect choice for those who hedge their bets or can't make up their minds. Its basic chassis lets you upgrade or alter your system not just between microprocessors (80286 or 80386) but also buses (classic AT or Micro Channel). You can double your expansion slots when the need arises or put both the AT and MCA buses into one machine.

At least that's the idea. Technical problems, however, have delayed the introduction of key components (like the MCA circuitry). But keep to one bus and the CompuStar still looks mighty impressive. Its hyperpituitary box—measuring 24 by 7½ by 24 inches (HWD)—towers above other compatibles and even many mini-computers. A full-length foot broadens its base to 12½ inches.

Made not from stamped steel but heavy aluminum extrusion, it's built stronger than many automobiles and probably some trucks and diesel locomotives. On the other hand, the fold-down handle on top must be either a joke or a request from a manufacturer of trusses.

INTERNAL DESIGN

The interior structure of the CompuStar is held together by several fiber-reinforced plastic subchassis and has mounting areas



Besides being possibly the sturdiest PC yet built, the \$4,070 Wells American CompuStar 286 (1MB RAM, 42MB hard disk, VGA monitor) is filled with many convenient features. For instance, the hard disk near the top of the case snaps into place, latched securely by a large plastic level. The drive can be installed or removed in seconds with little effort and no tools.



for a number of circuit boards. A long, narrow system board runs horizontally from front to back across the chassis. As with most of these high-speed 80286s, the CompuStar is primarily built around the Chips and Technologies NEAT chip set and uses a Harris 80C286 microprocessor; both are fully rated for the 20-MHz maximum speed of the system. Shadow RAM and full EMS 4.0 hardware support for system board memory are implemented. A setup program for the NEAT chips is the only software that comes with the system. An overall system setup routine is built into its BIOS.

The system can be slowed to 16, 12, 10, 8, or 6 MHz using the keyboard or a front-panel turbo switch. A small, four-digit display indicates the operating speed. When the system operates above 10 MHz, expansion bus speed is one-half the microprocessor speed; at 10 MHz and below, the bus runs at the full speed of the microprocessor.

SYSTEM BOARD

The system board reserves two areas for adding memory in the form of proprietary modules, up to four modules per area. In the evaluation system, the modules were each packed with 18 ZIP (Zigzag In-line Package) 1 by 256-kilobit 80-nanosecond RAM chips, totalling 512K bytes per module. From Wells American, such modules are somewhat expensive (\$345 for 512K bytes). Two-megabyte modules are also available, furnishing the system with up to 16MB of high-speed RAM on the system board. For do-it-yourselfers, Wells American also offers unpopulated modules that

accept standard DIP chips.

Standard I/O circuitry built into the CompuStar includes two serial ports and one parallel. Connectors for these are arrayed on the rear of the machine, along with keyboard and mouse connectors and DIP switches to select video mode. Both digital 9-pin and analog 15-pin video connectors are available; one serial port uses a 9-pin D-shell, the other a 25-pin. The parallel port uses a standard female 25-pin D-shell.

The only problem with the CompuStar system board is that it is supported at only one place along its length—and weakly at that—not at all in keeping with the rugged construction of the rest of the machine.

The system board offers no expansion slots of its own. Instead, it attaches to one or two bus adapters on either side. The currently available adapters for classic AT bus yield six 16-bit slots and one 8-bit; adding a second adapter extends expansion options to 13 slots (internal structures prevent one slot from being used). Note, however, that space for only 11 retaining brackets is available on the rear of the CompuStar.

EXPANSION SLOTS

The expansion board area is covered with an aluminum panel that snaps into place, helping to keep emissions down. Although the evaluation system reviewed was only FCC Class A rated, Wells American re-



FACT FILE

Wells American CompuStar 286

Wells American Corp., 3243 Sunset Blvd., West Columbia, SC 29169; (803) 796-7800

List Price: With 512K RAM, 1.2MB 5¼-inch floppy disk drive, \$2,615; with 1MB RAM, 42MB hard disk, monochrome monitor, DOS 3.3, \$3,770; with VGA monitor, \$4,070; with 150MB hard disk, one 1.2MB 5¼-inch and two 1.44MB 3½-inch floppy disk drives, \$6,550.

In Short: What more can you ask of a computer than that it be infinitely expandable? Start with an 80286 microprocessor running at 20 MHz, and the CompuStar's chameleon design will allow you to eventually convert to 80386 operation, add expansion slots (to 13), and use Micro Channel operation (not yet available).

CIRCLE 466 ON READER SERVICE CARD

386²⁵ • 286¹⁶ WITH 2MB LOADED



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PM 386-25

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- ON BOARD SERIAL, PARALLEL, GAME PORT
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- 150 WATT POWER SUPPLY
- MINI DESK TOP CASE
- MONOCHROME GRAPHIC CARD & MONITOR
- UNIVERSAL FLOPPY DRIVE CONTROLLER FOR 1.44MB, 1.2MB, 720KB & 360KB DRIVES

\$690

PM386-25

VIDEO OPTIONS

DRIVE OPTIONS	MONO	EGA/COLOR	VGA/COLOR
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108MB RLL 1:1	3099	3419	3719
142MB ESD 1:1	3499	3819	4119

PM286-16

VIDEO OPTIONS

DRIVE OPTIONS	MONO	EGA/COLOR	VGA/COLOR
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ports that Class B certification is pending.

Underneath the expansion adapters is a large circuit board that holds the standard-equipment VGA circuitry of the CompuStar. In testing, this proprietary adapter, which is based on the Paradise VGA chip, matched the compatibility of most other third-party VGA boards. It was among the fastest tested.

In keeping with the virtues of volume, the CompuStar yields more drive mounting space than virtually any other compatible on the market: four half-height 5¼-inch drive bays and two 3½-inch bays poking through the front panel plus an internal full-height hard disk mounting area. Floppy disk bays are aluminum extrusions about ¼ inch thick. Drives mount with AT rails and proprietary front-panel brackets held in place by Torx screws. A Torx wrench is conveniently stored inside the machine. The internal hard disk latches easily in place with a large plastic lever.

OTHER FEATURES

Standard equipment includes one 1.2MB 5¼-inch floppy disk drive (a TEAC FD-55GFR in the evaluation unit). Up to four floppies can be operated by the controller circuitry built into the system board. Two Mitsubishi MF55B 3½-inch floppies were also installed in the evaluation unit.

Both hard disks and controllers are optional with the CompuStar. In the evaluation system, a 150MB Maxtor XT-4170E (\$1,995) was installed, operated through an Adaptec ACB-2320 hard-disk-only ESDI controller (\$215).

Power for the system comes from a 220-watt power supply, physically identical to a standard AT supply and capable of operating at either 115 or 230 VAC, switch-selectable. It provides seven power connectors for disk drives. The power switch is up front on the control panel. There you will also find a reset switch and a key lock that prevents removal of the front panel (and thus access to the machine) but does not lock the keyboard.

Wells American took pains to get the details of the CompuStar right. For instance, extra drive rail retaining clamps are screwed into the system behind its decorative front panel, enough for all the drives you might want to install. In addition, the monitor, keyboard, and even system BIOS were all marked with the Wells American name. The display proved excellent, a re-labeled Zenith 14-inch color FTM ZCM-1490 VGA monitor. The 101-key Enhanced keyboard is available with either

IBM or Compaq feel—that means with or without clicks.

The overall good workmanship is complemented by a 1-year warranty and 31-day money-back guarantee. On-site service is available but not included in the purchase price.

Even if the Micro Channel adapter for the CompuStar never becomes available, this machine deserves serious consideration as probably the most rugged PC yet made. Although somewhat expensive compared to the competition here, the CompuStar will likely withstand more abuse than virtually any other IBM-standard machine in its class.

ZEOS INTERNATIONAL LTD. Zeos 286-20

One of the first makers of 80386-based system boards, Zeos International has gone on to become a manufacturer of solidly made, low-end computers. The Zeos 286-20 represents a retrograde step to 80286 technology, a hard-core AT clone—but one with nearly three times the performance of the classic IBM machine. Price puts it on par with—maybe even above—others in its class: an enticing \$2,095 for a system that comes with a

32MB hard disk, lacking only a display.

Those bucks buy all the refinements that have become standard equipment in today's high-performance computers—built-in hardware to convert extended memory into EMS 4.0 (with the supplied software driver), shadow RAM, and (with some memory options) interleaved memory.

Physically, the Zeos is run of the mill, not so much inspired by the AT as photocopied from it. Dimensions are an exact match; styling is more derivative than reminiscent. The mass-storage mounting options of the two machines are identical with the exception of the 286-20's third open half-height drive bay. As with most of today's compatibles, the Zeos 286-20 adds cutouts for mounting I/O connectors on the rear panel: two for 9-pin D-shells and three for 25-pin D-shells.

The front control panel reveals the only other major difference between the 286-20 and its predecessor: giant, inch-high green numbers to give you a misleading indication of the operating speed of the Zeos—a big 20 for its top speed and a big 8 for its 10-MHz reduced-speed operation, an oversight in the evaluation machine that Zeos is planning to correct with the release of the next model.

The control panel also includes membrane switches for selecting reset and turbo functions, the last of which did not work reliably—another oversight, according to Zeos. The alternative for selecting



The chief difference between the Zeos 286-20 and most other AT clones is the huge numeric display on its control panel that supplies a misleading indication of the system's operating speed: a 20 for its 20-MHz top speed and, unaccountably, a big 8 for 10-MHz downgraded performance. \$3,093 gets you 1MB RAM, 65MB hard disk, and VGA monitor.



**Zeos 286-20**

Zeos International Ltd., 530 Fifth Ave. NW, St. Paul, Minnesota 55112; (800) 423-5891
 List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, 32MB hard disk, monochrome monitor, \$2,095; with 65MB hard disk, DOS 3.3, \$2,395; with VGA monitor, \$3,093; with 2MB RAM, \$4,833.

In Short: An AT carbon copy with improved performance thanks to its 20-MHz 80286 microprocessor. Systems with 1- or 4MB operate with interleaved memory and achieve 20 percent better performance than systems otherwise configured. A good bet at a good price.

CIRCLE 467 ON READER SERVICE CARD

speed—pressing the Ctrl-Alt-Numeric Minus key combination—did slow the system down. A cylindrical key switch on the control panel locks the keyboard.

SYSTEM BOARD

Again, as with most of today's compatibles, the Zeos system board is built mostly from the Chips and Technologies NEAT chip set. The system gains its identity from a Phoenix BIOS, which requires a floppy-disk-based setup program (included with the system). The brains behind the system is a Harris 80C286, rated (as are all the system's major chips) at the full 20-MHz clock speed.

The system board accepts up to 36 memory chips using offset sockets for either 256-kilobit or 1-megabit dynamic RAM chips. All chips in the evaluation unit were rated at 100 nanoseconds. Depending on the amount of memory installed, the system operates with one wait state or with near-zero wait states with memory interleaving. All 36 sockets must be filled for interleaving, so 1- and 4MB systems are fast; 2MB systems lag behind by about 20 percent.

Additional memory can be added through a proprietary 16-bit expansion connector that shares board space with one of the Zeos board's 8-bit expansion slots.

A socket is reserved for an 80287 numeric coprocessor, but installing the chip yourself is a forbidding interlocking puzzle. Because the socket is hidden by the hard disk bay, you'll first have to remove the drive. But before you can remove the drive, you'll have to remove the front control panel because it overlaps one of the drive mounting screws. Save your gray matter (and knuckles) and order your coprocessor already installed.

TESTED CONFIGURATION

In the evaluation unit, the hard disk was a Seagate ST-277R, which is not an outstanding performer—its average access time is around 33 milliseconds. Coupled with the optional (\$995) Distributed Processing Technology controller that Zeos packed into one 16-bit expansion slot of the evaluation machine, speed is commendably fast, thanks to the board's built-in 512K cache. The standard equipment controller is an Adaptec 2372B, which uses RLL data coding for the hard disk. This board also controls the standard-equipment high-density 5¼-inch TEAC FD-55GFR floppy disk drive normally included with the system.

Another of the six 16-bit slots on the system board is filled with a Paradise Systems VGA Professional video board, a \$150 upgrade. One of the two 8-bit slots was filled with an I/O board that offers one parallel port, one serial port, and one game port. This board will produce a second serial port if you add another 16450 UART chip and a cable, a feature slated to become standard equipment in the Zeos 286-20.

OTHER FEATURES

The A-Matic power supply delivers 230 watts to four drive connectors. The power supply operates from either 110- or 220-volt 50- or 60-Hz line current, selectable by a rear-panel slide switch; it also has an outlet for a display. Power for the system board time-of-day clock and CMOS configuration memory is derived from a rechargeable nickel-cadmium battery soldered to the system board itself.

Zeos supplies a Nan Tan Computer Company (Taiwan) keyboard with the Zeos 286-20. A copy of the 101-key Enhanced Keyboard, the Nan Tan also mimics the IBM sound and tactile feedback quite well. The display included with the evaluation system was a Tatung CM-1495 color 14-inch multiscanning display, \$795 from Zeos.

Although the chassis of the Zeos 286 is medium weight, it's still quite flexible, which may imperil the system board if you're not careful when the lid is off. Otherwise construction and workmanship are average or above. In fact, the system has earned FCC Class B certification. The Zeos warranty lasts 1 year and, according to the company, on-site service will soon become part of that offer.

The Zeos 286 is a good choice for a fast

**• Dell System 220**

This article represents the second time we've looked at a group of 20-MHz 286s; our previous roundup, "The 80286: Unsafe at Higher Speeds?" appeared in our issue of December 27, 1988. It was a particularly memorable event: after weighing the merits of these machines against those of 80386-based PCs, we decided to award the Editor's Choice not to any of the six machines we tested, but to the 80386.

That decision was based on a couple of factors that are no longer in play. The most pressing was the overoscillation of every chip in the group; because the machines shipped before the release of Harris Corp.'s 20-MHz 80286 microprocessor, each company used a crystal to bump the performance of its 16-MHz 286 chips up to 20 MHz. And the prices of the first six 20-MHz 286s to hit the market were pretty steep, usually \$3,000 to \$5,000 for a fully configured machine. The current crop keeps prices down in the \$2,000 to \$3,000 range, in line with their mid-speed 286 siblings.

The Dell System 220 is a shining example of high-end 286 computing at its best. It's an engineering tour de force: petite, solid, sleek, and fast. VGA circuitry is built onto the system board, as are the serial and parallel ports and a two-drive floppy disk controller. High quality comes at a high cost—\$3,299 for 1MB RAM, 40MB hard disk, and VGA monitor—but even at that level the System 220 still isn't the priciest in the group. If no arguments can persuade you to spring for a 386SX or low-end 386 machine, you can't find a better high-speed 286 than the Dell System 220.

AT clone. However, you'll want to be picky about the amount of memory installed to ensure that you get the full performance that the system is capable of delivering. ■

John Dickinson is an executive editor of PC Magazine. Winn L. Rosch is a contributing editor of PC Magazine.

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- 1 Serial Port & 1 Parallel Port
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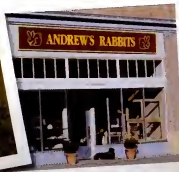
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CFO Advisor

Financial Analysis Beyond Spreadsheets

by Mike Falkner

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It was not long ago that you could create financial projections only with minicomputers and mainframes loaded with

expensive software. Thereafter, thanks to the introduction of spreadsheets like VisiCalc and SuperCalc in the late seventies and early eighties, PCs quickly became the tool of choice for forecasters. The innovations of Lotus 1-2-3 and Javelin allowed models to grow larger, but even with these new products your analysis was still bound by the limits of the programs' formula capabilities.

CFO Advisor, a \$995 financial analysis package from Fi-



Financial Feasibilities, begins yet another era of PC-based financial analysis, merging the flexibility of a spreadsheet with the sophistication of a specialized, preprogrammed product. After all, an analysis conducted in 1-2-3 is only as good as the formulas you write. Designed for both the novice and the seasoned veteran of financial forecasting, *CFO Advisor* uses the graphical interface of *Microsoft Windows* to capture information, display the results of calculations, and present an array of analysis options using pull-down menus.

The opening screen of *CFO Advisor* has the familiar look of a *Windows* application. A lone menu option, File, is your obvious choice, and from it you create a new scenario or open an existing file. Oddly enough, there is no quit option in the menu; you must double-click with the mouse on the control menu box to leave the application.

When you create or load a file, *CFO Advisor* displays a screen called the Blueprint, the focal point of the entire package. Although it appears intimidating at first glance, a closer look reveals a well-planned layout of balance sheet values, income statement items, and financial ratios connected by lines that symbolize relationships between data. For example, sales minus cost of sales equals gross profit, so a line on the Blueprint connects these three items. Bowing to the needs of novices, the program also lets you select an alternative Blueprint that presents a more traditional view of the data.

Financial Feasibilities bases *CFO Advisor* on the Du Pont return-on-net-assets theory. Using information from a company's financial statement, this method relates items and generates ratios that measure how efficiently and effectively management uses its resources in three categories: profitability (net profit over sales), activity (sales revenue over net assets), and return on net assets (profitability times activity). Data is grouped into key performance areas that management can control and key results areas (like cash flow) that show the effect of management's use of its resources.

LOADING THE DATA

As is the case with any analysis, you must load data into a model before you can analyze it, and *CFO Advisor* gives you several ways to do it. If you just want to enter basic financial data, you can load it quickly by summarizing your financial statements within the categories shown on the screen.

To enter the data, you simply click the mouse on a field and type in the value while *CFO Advisor* calculates totals and ratios as you go. Since the program works on only a single period, you must enter the number of days in that period. The program also has a choice in the help menu, Show Input Fields, that highlights the fields that accept data to help you avoid changing the wrong field.

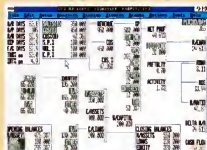
For those who want to see the detail behind the Blueprint, *CFO Advisor* provides a Detail Input screen for entering your entire chart of accounts. If you've never used the screen, you are prompted to create or load a file with the detail input information. Using the F2 key to append records, you enter the account number, the account name, and the amount. Although the screen is well laid out, it is clumsy to use. The Tab key doesn't move the cursor, so

you have to enter a number and use the Right Arrow key to make the cursor move. The program is slow in capturing keystrokes, and it completely rewrites the screen after you enter each field, adding a little time lag to the process.

IMPORTING ACCOUNTING DATA

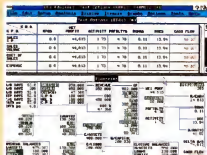
If you use one of four PC-based accounting packages (*ACCPAC Plus*, *CYMA Professional Accounting Series*, *RealWorld Accounting System*, or *Solomon III*) or *Lotus 1-2-3*, you can purchase an optional Interface Pak (\$95) and load the detail input from your chart of accounts files or 1-2-3 spreadsheets. From the Setup menu, you select the accounting package and the period to convert, and *CFO Advisor* loads the information. Tests of both *ACCPAC Plus* and *Solomon III* files ran quickly and accurately. If you want to convert your 1-2-3 files, you must take a predefined 1-2-3 spreadsheet that comes with the software

THE NEW LOOK OF FINANCIAL ANALYSIS



The Blueprint is the first screen that appears in *CFO Advisor*. The lines connecting numbers across the display symbolize relationships among the data. You can enter new information into a model, modify the scenario, and review the results of all your changes on this one screen.

You can split *CFO Advisor*'s screen vertically or horizontally into two windows. As you experiment with different scenarios in your model, you can test them by transferring their information to the Blueprint and noting the total effect of the change.



and fit your accounts into its structure. From there, a few steps take you through the conversion.

CFO Advisor hard-codes the information on its Blueprint. For example, there is just one revenue field and one cost-of-sales field on the Blueprint. Every general ledger has a chart of accounts listed in numbered categories (1,000 Cash, 1,100 Acct Receivable, 5,000 Sales-widgets, 5,100 Sales-gadgets, and so on). You can load the chart of accounts into *CFO Advisor*'s detail screen by using the Match Accounts function, which assigns every item in your chart of accounts to one of the Blueprint categories. The two sales accounts mentioned above would be assigned to the one sales category that is charted in the Blueprint screen.

If a chart of accounts doesn't give you enough detail, you can create files that itemize sales, cost of sales, fixed assets, inventory, operating expenses, and admin-

istrative expenses. In the sales, cost of sales, and inventory screens you add a description of the item, the number of units desired, and a price or cost. In the fixed-asset screen, you enter cost, annual depreciation, and accumulated depreciation because *CFO Advisor* does not calculate fixed-asset depreciation. The expense detail screen requires only the entry of fixed and variable expenses. In all cases, the program automatically calculates the account totals and compares them with the current Blueprint value at the bottom of the screen.

Once you've entered information in any detail screen, you must move the data to the Blueprint with the program's Transfer option. It's not an automatic procedure, and you need to do it each time you change the detail. In addition, you should remember to turn on automatic recalculation in

the Blueprint to ensure that your screen is updated properly.

TAKING ACTION

Here's how *CFO Advisor*'s features can save you time and deliver information far beyond the power of a spreadsheet. Suppose you own a company and want to acquire another one. Two prospects look good. You keep your general ledger in *ACCPAC*, and the other acquisitions are willing to give you their books, one electronically in *Solomon III* and one on paper. You want to look at the effect of the acquisition on your company as a total unit.

In 1-2-3, you'd have to build a balance sheet, profit-and-loss statement, and cash-flow statement. You'd then build an assumption, develop all of your own ratios, create a sensitivity analysis section, draw your own graphs, and hope you didn't make a typing mistake somewhere. You'd have to develop custom spreadsheets for the mergers of company one and company two since they have different charts of accounts.

In *CFO Advisor*, much of the process is automated. You'd load your ledger and match the accounts to the Blueprint. Then you'd analyze your position and save it. After that, you'd load company one, analyze it, consolidate the two companies automatically, check the ratios to see where you stand, and save the consolidation scenario to disk. Then you'd load the other company manually and save it. Analysis would start when you cut some overhead costs on each of the consolidated Blueprints and used the Compare Files function to see the effects of your changes.

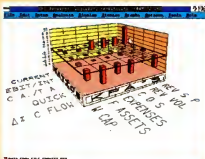
You could analyze these acquisition scenarios in 1-2-3 and get some results, but you would spend massive amounts of time doing it, only to end up with results that wouldn't be nearly as complete or flexible.

THE SCREEN PARADE

Once you've got your information into the Blueprint, *CFO Advisor* gives you myriad ways to view the data. The Blueprint is very informative and a valuable tool by itself. Nevertheless, you'll find 14 other well-designed screens in the Display menu that start you thinking about the kinds of analyses you can perform.

The screen parade starts with a traditional balance sheet and income statement that use the same categories as the Blueprint. The product-analysis screen compares revenue and cost-of-sales information entered in the Itemize screen and gives

CFO Advisor includes more than a dozen types of graphs to help you visualize the effects of changes to your data on different areas of the Blueprint. Here, ratios generated by the model are being compared with key performance areas. If you don't like the colors or the 3-D effect, you can customize your output.



Source: CFO ADVISOR



Here, *CFO Advisor*'s Dynamic Data Exchange with Microsoft Excel has been activated to bring spreadsheet capabilities into the Blueprint. After you set up the interface, the changes you make in Excel are sent to the *CFO Advisor* Blueprint and the data there is updated automatically.

you both gross profit and contribution percentages. The remaining screens show both key ratios and the sensitivity of certain figures to changes in others.

The activity ratios show the turnover of inventory items and current accounts and are meant to measure how efficiently management uses its resources. As with the other ratio screens, the screen shows the ratio, its formula, and its value. The leverage ratios show you how your company's assets are financed, and the liquidity ratios relate how well you are prepared to meet your outstanding debts. The profitability ratios include items that indicate how effectively your company uses its resources, such as Return on Equity. The market ratios reveal the performance of your compa-

ny per share of outstanding stock.

Although these ratios are good indicators of problem areas, *CFO Advisor* also includes sensitivity screens that vividly depict the effects of changes in a key performance area on profit, cash flow, and other key result areas. The program arranges (in tabular form) the key performance areas on the left, the result areas along the top, and the calculated effect of a 1 percent increase or decrease at the intersection of each item. For example, in order to see the dollar effect on cash flow of reducing accounts receivable by 1 percent, you would find Accounts Receivable on the left and then follow it to the value that is

under the column titled Cash Flow.

In 1-2-3, you can set up data tables so that you can plug several values into one or two cells and get several calculations of a formula. For example, you can enter five sales figures, and 1-2-3 will return five profit amounts, but you can do only one data table (that is, one scenario on one or two variables) at a time.

CFO Advisor's sensitivity analysis calculates several scenarios at once and displays them together. On three screens you get 15 analyses that show what a change to a key performance factor will do to six key-result areas. For example, a 1 percent increase in sales affects six result areas. To see those results in 1-2-3, you'd have to write a macro that put "1 percent" some-

DEFINING YOUR TERMS: A Financial Analysis Glossary

Blueprint The master screen in *CFO Advisor* that summarizes all available financial information, generating the statistics needed to measure management performance. The screen includes manually entered data, calculated fields, and lines that graphically represent the relationships between various pieces of information. It's a great tool for quick "what-if" questions.

Cash flow The funds resulting from acquiring and using noncash assets as well as incurring or reducing debt. For example, selling a product on account does not generate cash since one asset, accounts receivable, is increased while another asset, inventory, is equally decreased. However, collecting on the account reduces the asset and generates cash flow.

Du Pont return-on-net-assets-model A model that measures how efficiently management uses its resources and how profitably it applies them. You perform this measurement by using a company's financial information to generate a series of ratios based on activity, profitability, and net return on assets.

Financial ratios Calculated indicators that measure a business's financial performance. Although the values may look meaningless on their own, they give the financial community a basis for comparison with industry

Before you try to use
CFO Advisor or any
other financial
analysis tool, make
sure you know the
jargon of the trade.

standards and other companies' performances.

Fixed and variable costs In the normal operation of a company, costs are incurred so that a profit can be made. Fixed costs, such as loan payments, seldom change from month to month, and management has little control over their amount. Variable costs, such as office supplies, can change based on usage or management discretion, and they can be controlled through proper management.

Goal seeking Calculating a result in a key performance area based on changes to a financial parameter in a key results area. For example, to reach a certain cash flow (a key results area), you want to know how much you must increase the sales

price of your product (a key performance area).

Key performance areas Financial categories, such as sales and operating expenses, over which a company has control. The company is able to manage the performance of these areas and make changes when necessary.

Key results areas Financial categories, such as gross profit and cash flow, that are affected by activities in the key performance areas. They are a measure of how well management is using and controlling resources.

Leverage ratios Indicators that show how a company's assets have been financed. For example, if the ratio of loans to total assets is low, the company has few debts and may be able to absorb more debt in order to expand.

Liquidity ratios Indicators that show a company's ability to repay short-term obligations. High liquidity indicates that a company should be able to pay its debts on time without selling its assets at less than market value.

Sensitivity analysis An examination of the effects of changes made in one financial area on another. By analyzing these effects, management can identify areas where changes will yield the most benefit (or the least detriment). ■

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where and copy the six calculated result areas to an area for display. Then you'd have to run the same macro for the other 14 analyses so that you had the equivalent of *CFO Advisor's* three screens. In short, you'd have to write pages of macros and have special areas all over your spreadsheet to keep them in.

Three other *CFO Advisor* screens show different key performance areas compared with net-profit, cash-flow, activity, profitability, return-on-net-assets, and return-on-equity ratios. Three more screens show the effect of the same key performance areas on liquidity, leverage, and profitability ratios.

ANALYZING THE DATA

Once you've identified areas of concern, you can use an impressive set of tools to change and analyze your numbers. The simplest changes can be entered directly onto the Blueprint. You click on a data item and change it, and the Blueprint recalculates. All of the ratio and sensitivity screens are also updated automatically.

By using the View Changes option in the analysis menu, you can display a comparison of several Blueprint items as they stand now versus their previous value. You can also leave the View Changes window on the screen while you modify the Blueprint, and both will change as you work.

More often than not, your analysis requires changes to some of the small details behind a Blueprint number. Using the Detail Input screen, you can perform mini-analyses on data that you've entered, without changing the Blueprint. You can change actual quantities, prices, and costs as well as increase or decrease any of them as a percentage of their former value. In the expense screens, you can move fixed costs to variable costs or change costs as a percentage of revenue. As before, the new values are compared with the Blueprint at the bottom of the screen. When you've got the figures you want, you must transfer them manually to the Blueprint.

As you generate several scenarios, you may want to save some of them for later review. Using the menu choice Number Ext, you can instruct *CFO Advisor* to save the Blueprint as a new file. The program uses the same filename and changes the file extension to a sequential number starting with 000. The next scenario is assigned 001, and the sequence continues as long as you save with the Number Ext menu choice. To set the Blueprint back to its

original values, just use Revert and the program reloads the default Blueprint.

Just as the ratio and sensitivity screens help you spot problem areas, so do the test-options and seek-alternatives screens help you search for answers. They are laid out in a matrix format, with key performance areas on the left and key result areas along the top. Instead of percentages, the calculated values shown on the screen represent the actual amount or ratio, so you can see the full effect of a change instantly. A few keystrokes can tell you, for example, that a

Once you've identified areas of concern, you can use an impressive set of tools to change and analyze your numbers. The simplest changes can be entered directly onto the Blueprint.

2 percent change in sales will have a 5 percent effect on your profit, while a 1 percent change in sales will hardly affect the profit at all.

The three menu choices for test options allow you to enter a percentage change to a key performance area and test the effect of the change on net profit, cash flow, and several performance ratios. Each key performance area, or row, is independent of the others. If you change the sales percentage on the first row, for example, you'll see the effect on net profit and the other result areas shown across the screen. An increase in the cost-of-sales percentage, shown in the third row, affects the same items but only for the third row. When you're done, you can review all scenarios without changing the Blueprint.

The three seek-alternatives screens use the same basic layout as the test-options

screens. However, instead of changing key-performance-area percentages, you enter the actual value that you want in the key result area. *CFO Advisor* then calculates the value needed to reach that amount and displays the percentage change needed to reach it in that key performance area. For example, if you want a net profit of \$100,000, you enter that amount, and the program calculates the new sales revenue and other key performance figures needed to earn such a profit. Each column is independent of the others, so you can view six scenarios on your screen at once.

GOAL SEEKING

One of the most powerful tools in *CFO Advisor*, and one of the things that spreadsheets really can't do without a huge effort, is goal seeking. Instead of having you enter detail items and calculating results and ratios, *CFO Advisor* will accept a desired result and solve backward for the value needed to reach it. You know what you want, but you want to know how to get there. To achieve a certain cash flow in a spreadsheet model, you could play with the sales price until you reached it. However, with goal seeking, you simply identify the performance area, sales price, as the goal and then enter the desired cash-flow. The program calculates the sales percentage needed for the cash-flow number and makes changes to other affected data items. You can even perform two goal seeks at a time.

In the previous merger example, you could use goal seeking to see what kind of sales figures your new company would need to get the return you specified.

After you've toyed with several scenarios, you can compare them on one screen using the Summarize option. Depending on the option you choose, the screen shows several key performance areas or key results areas along the top with their values along the row underneath. You then use the F2 key to append other scenario files to the screen. The program displays the new scenario and the difference between it and the currently loaded Blueprint. Once you've decided on the best scenario, you can use the Compare Files option to load it into memory and compare it with the current Blueprint. The screen shows both the key performance and key result areas on the screen with both the absolute and percentage differences.

Most spreadsheet models run from the bottom up. You enter data, play with it, and generate your result. Goal seeking re-



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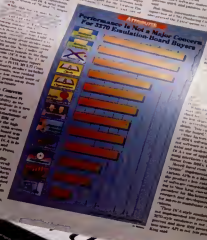
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lies on models that work from the top down. You start with the result and work back to the data that will cause it to happen. To achieve true goal seeking with 1-2-3, you'd need a whole set of spreadsheets, each one of them crammed with formulas you'd have to write.

CFO Advisor analyzes only one company for one period. However, the program allows you to merge scenarios, so you can consolidate divisions or test the effects of an acquisition. You can also merge periods for the same company if you have created the figures in separate scenario files. Using this option, the program keeps track of beginning and ending balances so that they are adjusted instead of added. You must consolidate periods from last to

are rendered in pies. Sensitivity analyses, where key performance areas are compared with key result areas in a matrix, are shown as 3-D charts. With the Setup option, you can also add or remove items from the chart to better highlight a certain condition. By identifying a second scenario file, you can change any graph to a comparative display.

When you print a report, you can enter several lines of text to appear at the top of the page, and you can check several boxes to enable date and time printing, page numbers, your company's name, and a file reference. Don't expect quick results, however, because **CFO Advisor** includes graphics output in almost all of its reports. A four-page list of the chart of accounts took almost half an hour to print on an HP LaserJet Series II, and graphs aren't produced any faster.

The documentation consists of both a user manual and an applications guide. There is a good explanation of the **Windows** basics for novice **Windows** users. After a brief introduction you immediately start a lengthy **CFO Advisor** tutorial, which brings you up to speed pretty quickly. If you're a novice business user, however, you may want to read the financial reference section that accompanies the tutorial before getting started. It provides a good overview of the Du Pont theory and explains every **Blueprint** category in detail.

The user manual also includes a reference section that describes each menu choice and a helpful section on how to enter your own data. In addition, there is a separate applications guide that does an excellent job of describing how you should handle analyses of common business problems such as capital planning and break-even analysis. Augmenting the manual is a complete on-screen help capability. By setting a menu choice, you can display a help message for a screen, a data item on the screen, or a menu command. These messages are especially useful when you've forgotten the formula for a ratio.

There are also several handy tools that make **CFO Advisor** a little easier to use. You can split the screen horizontally or vertically, so you can display the **Blueprint** in one window while viewing an analysis screen in another. **CFO Advisor** also features a dynamic data exchange link with **Microsoft Excel**. Although it's a tight squeeze to get both programs in memory at

once, the process involves loading a **Blueprint** and then running **Excel** in another window. You can enter data in **Excel** and watch it change in the **Blueprint**. Again, it's fairly slow, but slick to watch.

WISH LIST

CFO Advisor is a tremendous tool and it grows on you as you use it, but it's still possible to come up with a wish list of features and fixes for the next version. There's a lot of messy screen handling, especially in the detail input, which detracts

If you're resigned to
formula writing in
spreadsheets, you'll
delight in the ease
with which **CFO
Advisor** generates
data.

from an otherwise well-designed product. An optional depreciation calculation would be a nice addition, as would multiple interest rates in the loan calculations. Automatic consolidations for periods or companies would make things easier, as would a batch print facility. Even though it's explained fairly well, goal seeking is the hardest thing to visualize, and it is a good candidate for a dialog window with a little more help. You can fulfill parts of this wish list by using **Excel** and the data exchange, but the object is to get it all in a single package.

Version 2 of **CFO Advisor** should be spectacular, but version 1.01 is outstanding in its own right. If you're resigned to tedious formula writing in spreadsheets, you'll delight in the ease with which the program automatically generates vast amounts of data you've never been able to get from spreadsheets before. **CFO Advisor** may not change the way you do business, but it will change the way you look at your business. ■

Mike Falkner is a California-based micro-computer consultant and a frequent contributor to PC Magazine.

PC FACT FILE

CFO Advisor,

Version 1.01

Financial Feasibilities
Inc., 9454 Wilshire Blvd.,
Penthouse, Beverly
Hills, CA 90212; (800)
752-5556; (800) 247-
4452 (in Calif.); (213)
278-8000

List Price: \$995; optional Interface Pak, \$95;
Trial Pak without print and save functions, \$45
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disk, DOS 3.0 or later. Microsoft Windows 2.0 or
higher recommended; expanded memory
recommended when using Microsoft Excel and
dynamic data exchanges.

In Short: A powerhouse financial-analysis
package for the astute entrepreneur with PC
prowess. Uses Windows effectively for
presenting data and testing scenarios, but the
program is so sophisticated that you'll need either
some financial acumen and accounting
knowledge or plenty of time to learn to use it. Not
copy protected.

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first or the balances will not be handled correctly. With either option, all the ratios and percentages are recalculated to reflect the merged figures.

GRAPHING THE DATA

A financial analysis package wouldn't be complete without graphs, and **CFO Advisor** has 18 of them. Although the graphs are predefined as bar, pie, or 3-D charts, you can change their colors and styles through a Setup option in the Tools menu. Most graphs that include values and ratios, such as the leverage ratios or profit-and-loss items, are presented as bar charts while current assets and current liabilities

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TCP/IP for Multiplatform Networking

Since they first
emerged in the mid-1970s,
the TCP/IP protocols
have been among
the most effective tools
for linking PCs, mainframes,
VAXes, and other
dissimilar systems
in a network.

by Frank J. Derfler, Jr.

One of the most difficult problems that system integrators and managers face is connecting different types of computers in a network. As the number of PCs in an organization grows, so does the need to link those PCs to any of several minicomputer and mainframe systems.

In an ideal world, every computer would exchange information freely with every other computer, regardless of the name on the front panel or the processor and operating system inside. In the real world, even computers from the same manufacturer are often unable to exchange data.

There is, however, one Rosetta stone of the computer world that can link a wide variety of mainframe, minicomputer, and PC systems. That common denominator is called TCP/IP, and anyone who deals with PCs every day will appreciate its power. Just imagine a \$250 to \$500 software package that provides easy file transfers and simple electronic mail ser-



voices between PCs and many kinds of dissimilar computer systems.

TCP/IP stands for Transmission Control Protocol/Internet Protocol. *Protocols* are procedures for communications described on paper and agreed to by the people who design products. The TCP/IP standards are brought to life in software sold by many different companies.

WHAT THEY ARE

The TCP/IP protocols were developed by the U.S. Department of Defense when DOD scientists were faced with the problems of linking thousands of dissimilar computers. The DOD paid companies like IBM, Honeywell, and Sperry (now Unisys) to develop TCP/IP software for specific computer-and-operating-system combinations used in the government. This seed money was well spent because it motivated these and many other companies to use their own funds to get onto the TCP/IP bandwagon. (See the sidebar "From DARPA to DOD to MIT to ARPANET: The Path to the TCP/IP Protocols" and the diagram "The TCP/IP Protocol Stack" to learn more about how the TCP/IP protocols were developed and how they work.)

In a typical TCP/IP network, a cabling and signaling scheme like Ethernet provides the basic links between dissimilar machines. Ethernet adapters are available for practically every type of computer data bus. The cable delivers data wrapped in an Ethernet packet to each machine. Computers with different operating systems and architectures that strip away the Ethernet packet do not know what to do with data that they have received from foreign machines unless they find further instructions. TCP/IP provides those instructions; the packets receive standardized handling when they arrive, regardless of the operating environment on the receiving side.

The TCP/IP module used by each machine must be customized for the computer and its operating system but standardized for the network. There are TCP/IP modules available for hundreds of different mainframe and minicomputer systems and for many different PC networks.

Nationwide and international networks of dissimilar computers are assembled in basically the same way as are Ethernet networks, except that long-distance transmission schemes (such as X.25 packet switching) carry the data instead of having Ethernet carry it. X.25 gateways on a LAN can provide TCP/IP-equipped PCs with

both local and long-distance connection capabilities.

HOOKING UP

PCs using TCP/IP to communicate with non-PCs usually talk over a local area network. Intelligent Ethernet adapter cards play an important role in the success of TCP/IP on the PC.

But TCP/IP isn't limited to Ethernet. IBM has an active program to provide TCP/IP connections over its Token-Ring adapters. The success of Token-Ring, despite its high cost and cabling hassles, makes the marriage of TCP/IP and Token-Ring increasingly important. The ability to run TCP/IP over Token-Ring and provide

The throughput of the TCP/IP gateway is more limited by the speed of the network than by its own translation activities.

seamless connections to IBM hardware are important IBM marketing lures.

There are two ways networked PCs can use TCP/IP. The first is to load a TCP/IP software module into every machine on the network. The second configuration uses one machine on the network as a gateway out to a TCP/IP network or device.

When your network has a great deal of interaction between different types of machines, it makes sense to give every PC its own TCP/IP module. The penalties you pay for putting the software on every machine are greater RAM use and more network overhead.

You can partially overcome these penalties by paying more money for intelligent network-interface cards. These cards can hold the TCP/IP code in their own RAM and take some of the work away from the PC's processor. TCP/IP software packages that are partially downloaded to intelligent network-interface cards take between 17K and 24K of active RAM. Packages that run on standard interface

cards occupy nearly 90K of RAM.

Setting up a TCP/IP gateway is the best solution for a homogeneous network of PCs that sometimes need access to a specific TCP/IP network or machine. The PCs on this kind of network do most of their work together using whatever PC-to-PC communications protocol the network provides. PC applications needing TCP/IP services send data through the gateway. The gateway translates between the PC's network protocol environment and the TCP/IP environment. The TCP/IP software typically runs on a machine dedicated to the gateway task.

The throughput of the TCP/IP gateway is more limited by the speed of the connection to the TCP/IP network than by its own translation activities. The connection between the gateway and the TCP/IP system can be through Ethernet coaxial cable, public data networks like Tymnet or Telenet, or private networks like the DOD's ARPANET, or by other means. If a TCP/IP gateway connects two Ethernet networks, it is called an *Internet router*. Since these networks are so common in TCP/IP installations, the phrase *TCP/IP router* is frequently encountered.

ABOVE TCP/IP

TCP/IP delivers data in a standard format and makes that data available for use in higher-level programs. The DOD standardized the protocol specifications for several other programs that take data from TCP/IP and do useful things with it. These protocols include the File Transfer Protocol (FTP), the Simple Mail Transfer Protocol (SMTP), and a terminal-emulation and communications program called TELNET. The specifications for these protocols are carefully described in DOD standards publications MIL-STD-1780, -1781, and -1782. In addition, efforts are underway to standardize the NetBIOS interface that was originally developed by IBM and Sytek.

Programs supporting the FTP protocol give people the ability to log into dissimilar machines across a network, use a standard command to list available directories and files, and exchange files with the remote machine. FTP can do some simple data-translation tasks like converting data between the standard ASCII alphabet and IBM's EBCDIC. FTP is controlled either through responses to command-line prompts or by commands passed from an application program.

The Simple Mail Transfer Protocol

A TCP/IP PRIMER: Decoding the Abbreviations of an Emerging Standard

ARPANET: Advanced Research Projects Agency Network. A network originally sponsored by the Defense Advanced Research Projects Agency (DARPA) to link universities and government research centers. The TCP/IP protocols were pioneered on ARPANET.

FTP: File Transfer Protocol. This protocol describes how one computer can host other computers for the purpose of transferring files in either direction. Users can see directories of either computer on the host and perform limited file-management functions. Software for the FTP client function is usually a part of TCP/IP packages for the PC; some vendors provide FTP host software for the PC. (See also *TFTP*.)

IP: Internet Protocol. IP software keeps track of the Internet address of nodes, routes outgoing messages, and recognizes incoming messages.

NFS: Network File System. A protocol based on IP, developed by Sun Microsystems. NFS servers provide full shared-file and printer support, and

NFS software is available for many different computers and operating systems.

NetBIOS: A program originally developed by IBM and Sytek to link IBM's network software and Sytek's network hardware. NetBIOS evolved as a grassroots standard interface for application programs.

PING: Packet Internet Groper. An exercise program used to test the Internet communications channel between stations.

SMTP: Simple Mail Transfer Protocol. The SMTP describes an electronic mail system with both host and user sections. Many companies sell host software (usually for Unix) that will pass mail to other proprietary mail systems, such as IBM's PROFS. The user software is often included as a utility in TCP/IP packages for the PC.

TCP: Transmission Control Protocol. This software bundles and unbundles sent and received data into packets, manages the transmission of packets on a network, and checks for errors.

TCP/IP: Transmission Control Protocol/Internet Protocol. Originally developed by the Department of Defense (DOD), this set of communications protocols has evolved since the late 1970s. Because programs supporting these protocols are available on so many different computer systems, they have become an excellent way to connect different types of computers over networks.

TELNET: A terminal-emulation protocol. Software supporting TELNET usually comes as a utility in a TCP/IP package, and all TELNET programs provide DEC VT-100 terminal emulation. Many companies either provide or allow other add-in emulators.

TFTP: Trivial File Transfer Protocol. A simplified version of FTP that transfers files but does not provide password protection or user directory capability.

UDP: User Datagram Protocol. This protocol describes how messages reach application programs within a destination computer. This protocol is normally bundled with IP-layer software. ■

lives up to its name. Programs supporting this protocol do little more than follow a strictly defined script used to enter and retrieve e-mail messages. Several companies market SMTP programs for different kinds of computers. The real advantage of this protocol is that the commands that save and retrieve e-mail messages are the same regardless of what machine acts as host.

The TELNET protocol describes the operation of a communications program that knows how to call for services from the TCP and IP software. The main purpose of software that implements the TELNET protocol is usually to convert the computer it runs on into a minicomputer terminal. Most of the companies include at least a DEC VT-100 terminal emulator in their TELNET packages. Some companies let you run special versions of popular terminal-emulation programs like Walker Richer and Quinn's *Reflection* on top of their TELNET software. This combination provides sophisticated emulation of Hewlett-Packard and other terminals.

Almost all of the products that support these higher-level protocols are designed to communicate with a large host computer. You can't get on a network and communicate between two PCs acting as peers using FTP, SMTP, or TELNET. However, some companies (FTP Software is one) include host programs that let a single PC become a host and conduct multiple simultaneous sessions with other PCs running TELNET, FTP, or SMTP software.

All of the companies covered in this review provide software conforming to these higher-level standard protocols, but the standardization of the NetBIOS interface is potentially more important to PC system integrators than the availability of the other protocols. Developers of PC software know how to write for NetBIOS. Workgroup productivity applications ranging from electronic mail to personal scheduling are available with NetBIOS interfaces. The introduction of NetBIOS into this suite of applications is a new development, and not all of the manufacturers have NetBIOS packages available.

Unfortunately, our tests show that the NetBIOS interfaces marketed by some of these companies do not play well together. We got a few of the NetBIOS products to exchange messages between different vendors' implementations, but only with a great deal of trial and error.

FILE-SERVER SOFTWARE

There are no federal standards for higher-level file-server software like *NetWare* or Microsoft's *LAN Manager*, but several of the companies marketing TCP/IP software have drivers that can be compiled into the *NetWare* operating system. Microsoft provides developers with most of the code needed to market TCP/IP drivers for the different OEM releases of *LAN Manager*.

Sun Microsystems markets file-server software called *NFS* for computers running the Unix operating system. The *NFS* software packages allow machines wearing many different nameplates to interact as file servers and clients through TCP/IP. Sun's *PC-NFS* is described in a separate review.

THE CHALLENGE

Our reviews show that PCs fit into TCP/IP networks very gracefully. Many companies will sell you TCP/IP software for the PC and for specific PC network environments. On the PC, TCP/IP software provides a fast and efficient way to exchange data with computers of different architectures running different operating systems.

We tested all of the TCP/IP products in this review with a 12-MHz Dell System 200 linked up to a 68020-based Sun-3/60 workstation. We felt this was an important and valid test because of Sun's prominent position in the high-end TCP/IP market. The 3/60 is rated at 3 million instructions per second (MIPS)—about the same as a top-end 80386-based PC—and has a base price of about \$10,000.

In this evaluation, we describe how you can use TCP/IP technology to link PCs, both individually and in a network, to a variety of non-PC computer systems. The product reviews themselves are relatively short because the TCP/IP software is invisible. If everything works right, the programs pass data without your ever seeing or influencing their activity. The reviews do tell you how to mix and match products from various vendors to get the exact combination you need for transparent communications. They also describe the file-transfer and file-server features that some companies supply in addition to basic TCP/IP features.

All of the eight companies in this review except for 3Com sell more packages through other companies than through their own channels. Sometimes the packages are relabeled and sometimes they carry the original logo. We tested the products from the original vendors; there was no point in looking at ten copies of the same software under different labels. Lists of who resells these products are included.

COMMUNICATION MACHINERY CORP.

TCP/IP for DOS

by Paul Ferrill

Communication Machinery Corp.'s entry in the TCP/IP race is called *TCP/IP for DOS*. The product uses a proprietary Ethernet interface board to hold the TCP/IP core software and to take much of the processing load off of the host processor. The ENP-66 Interface Board has its own Mo-

torola 68000 processor and functions as a standalone computer after the driver software is downloaded from the host PC. CMC sells a bundled hardware and software package called the PC Pack for \$925.

The *TCP/IP for DOS* package is resold by a number of companies, including Zenith Data Systems, Contel Federal Systems, Isicad, Trace, and Alpha Micro. Several of these companies do TCP/IP business with the federal government using CMC products.

Installation of the ENP-66 board is no problem, although its squared-off edge makes it a little tedious to insert. Once the board is inserted, the software is loaded from a floppy disk. The software installation is a question-and-answer session that configures the software for the specific network parameters needed to identify the node. Utility programs are provided to edit the configuration for any changes that may occur. A line must be added to the AUTOEXEC.BAT file to specify an environment variable that sets the terminal type. Three lines must be added to the CONFIG.SYS file to load the driver software correctly.

FTP, SMTP, and TELNET programs come in the CMC package. TELNET includes emulators for DEC VT-series, ANSI-standard, or dumb terminals. A special utility called TelTerm interfaces with terminal-emulation programs that can use DOS interrupt 14; this lets you use special emulators for Hewlett-Packard and other terminals.

CMC includes a *NetWare* interface as part of its \$925 package. The *NetWare* driver is compiled into the workstation shell during the *NetWare* installation process. This driver allows you to switch



CMC's \$900 *TCP/IP for DOS* PC Pack hardware/software combination package includes an interface board with its own memory to handle the TCP/IP implementation. The PC's main memory is left alone to perform its usual tasks.



FACT FILE

TCP/IP for DOS, Version 4.0
Communication Machinery Corp.
1421 State St.
Santa Barbara, CA 93101
(800) CMC-8023
(805) 968-4262

List Price: *TCP/IP for DOS*, \$300; ENP-66 Interface Board, \$695; *NetWare* support, \$25; all products bundled into PC Pack, \$925.
Requires: 24K RAM, DOS 2.0 or later.

In Short: A complete TCP/IP implementation including an interface board. The main portion of the operating software is downloaded into this board's memory, freeing up more memory in the host PC. A comprehensive set of documentation and program-development libraries makes this product very appealing to anyone wanting to write his own network applications.

CIRCLE 408 ON READER SERVICE CARD

among *NetWare*, TELNET, and FTP sessions without rebooting.

CMC's documentation comes in three binders and includes a Program Development Manual. Complete program libraries for use by the experienced C programmer are also included. These libraries allow you to write application programs that can communicate over the network in the same way the TELNET and FTP programs do. CMC provides an implementation of NetBIOS that worked well with Excelan's implementation.

The strengths of the CMC software are its small RAM size, good throughput, and C program interfaces. It is a particularly valuable product for people who want to develop applications requiring fast performance. The cost of the proprietary interface board, however, drives up the price of each installation.



The Seven-Layer TCP/IP Protocol Stack: Transferring Data Among Dissimilar Machines

by Frank J. Dertler, Jr.

7 Application programs

Database and other applications address NetBIOS.

Terminal-emulator programs address FTP.

Commercial e-mail programs address SMTP.

PC-NFS MS-NET LAN workstation redirector software addresses TCP or NetBIOS. It makes a server appear as a DOS drive.

6 NetBIOS program interfaces that address TCP

NetBIOS

FTP File Transfer Protocol software addresses TCP.

SMTP Simple Mail Transfer Protocol software addresses TCP.

5 Software that performs transmission-control delivery and recovery functions

TCP

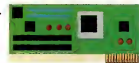
4 Software that recognizes Internet addresses and UDP routing

IP/UDP

3 Network adapter or serial port driver software

Driver Code unique to the hardware

1,2 Network adapter or serial port



To network

TCP layers

IP layers

This diagram is patterned after the typical ISO seven-layer protocol stack used to identify network structure. It shows the upward path through software and hardware that makes TCP/IP a viable means of data transfer among dissimilar machines linked in a network.

RS-232C to X.25, modem, or other services

THE INTERNET ADDRESS

The heart of the IP (Internet Protocol) portion of TCP/IP is a concept called the Internet address. This is a 32-bit coding system that assigns a number to every node on the network. There are various types of addresses designed for networks of different sizes, but you can write every address with a series of numbers that identify the major network and the subnetworks to which a node is attached. Besides identifying a node, the address provides a path that gateways can use to route information from one machine to another.

Although data delivery systems like Ethernet or X.25 bring their packets to any machine electrically attached to the cable, the IP modules must know each others' Internet addresses to communicate. A machine acting as a gateway connecting different TCP/IP networks will have a different Internet address on each network. Internal look-up tables and software based on another standard—the Address Resolution Protocol—are used to route the data through a

gateway between networks.

Another piece of software works with the IP-layer programs to move information to the right application on the receiving system. This software follows a standard called the User Datagram Protocol (UDP). You can think of the UDP software as creating a data address in the TCP/IP message that tells exactly what application the data block is supposed to contact at the address the IP software has described. The UDP software provides the final routing for the data within the receiving system.

MANAGING DATA DELIVERY

The TCP (Transmission Control Protocol) part of TCP/IP comes into operation once the packet is delivered to the correct Internet address and application port. Software packages that follow the TCP standard run on each machine, establish a connection to each other, and manage the communication exchanges. A data delivery system like Ethernet doesn't promise to deliver a packet successfully. Neither IP nor

UDP knows anything about recovering packets that aren't successfully delivered, but TCP structures and buffers the data flow, looks for responses, and takes action to replace missing data blocks. This concept of data management is called reliable stream service.

After TCP brings the data package into a computer, other high-level programs handle it. Some are standardized, like the File Transfer Protocol (MIL-STD-1780) and the Simple Mail Transfer Protocol (MIL-STD-1781). If you use these standard protocols on different kinds of computers, you will at least have ways of easily transferring files and other kinds of data. The trick is that you usually have to get the TCP/IP and other standard protocols from the company that markets each specific computer.

Conceptually, software that supports the TCP protocol stands alone. It can work with data received through a serial port, over a packet-switched network, or from a network system like Ethernet. It doesn't need to use or even know about IP or UDP, but in practice TCP is an integral part of the TCP/IP picture, and it is most frequently used with those two protocols.

EXCELAN INC.

LAN Workplace for DOS

by Paul Ferrill

LAN Workplace for DOS is the name of a family of products consisting of separate parts that work together. On the up side, this architecture allows excellent flexibility. On the downside, you must know exactly which combination of Excelan products to buy because they don't come in a single shrink-wrapped box.

The basic TCP/IP software module of *LAN Workplace for DOS* is called *TCP/IP Transport System*. This \$100 package provides the drivers for Excelan's proprietary network-interface adapters and the TCP/IP protocol software. *HostAccess* (\$150) adds the TELNET, FTP, and terminal-emulation utilities most TCP/IP users will want. *HostShare* (\$100) is a Microsoft MS-NET redirector; this software lets you access files and printers on an MS-NET host. *HostAccess/3270* (\$100) provides 3270 terminal emulation over TELNET. A \$50 NetBIOS package and a \$25 NetWare driver are also available.

All of this software runs on one of Excelan's Intelligent Ethernet Controller boards. The board used for this review was an \$835 EXOS 205T Ethernet adapter, a full-size card with an on-board 80186 processor chip. The processor allows Excelan's software to off-load a major part of the program to the board, leaving both memory time and processor time virtually

untouched in the host system.

After the board is installed, the menu-driven software installation follows. You select the packages you want to install from the main menu. The system can also run from floppy disks.

When the installation process is complete, all that remains is to create a table of host machines and load the driver software. A batch file is provided to install the driver software, and it can be copied into the AUTOEXEC.BAT file for transparent installation.

After the batch file that loads the driver software is executed, the system is ready to run. We used the TELNET program to connect to the Sun-3/60 machine acting as a host on the network. The program emulates a DEC VT-220 terminal with full functionality, including support of editors such as VI on Unix machines and EDT on DEC VMS machines. Excelan also markets a \$100 IBM 3270 terminal emulator for TELNET. In contrast to the fully equipped TELNET, Excelan's FTP program has no options, but it is quite functional nevertheless.

Excelan includes a NetBIOS emulator in *TCP/IP Transport System*. The version of the emulator we received worked most of the time with CMC's NetBIOS, but it would not recognize FTP Software's NetBIOS.

Excelan offers a separate package for *NetWare* called the *LAN Workplace Driver for NetWare/286*. This package provides object-code files that must be linked into the *NetWare* shell and the *NetWare* file-server program using the standard *NetWare* OS generation procedures.

The tight integration of *TCP/IP Transport System* with *NetWare* lets you use the

Like CMC's package, Excelan's *LAN Workplace for DOS* is a hardware/software combination. Pictured here is the \$835 EXOS 205T Intelligent Ethernet Controller card, which includes an 80186 processor. *NetWare* drivers are optional.



workstation shell to access both TCP/IP-based network hosts and Novell *NetWare* servers.

Excelan distributes its products through VAR, retail, and OEM outlets and through international distributors. Support is provided through dealers, through regional offices, and from the factory via a toll-free number. The product is very easy to install and performed well in testing, but the high cost of the proprietary Ethernet interface board needed to run the software runs up the price of each installation to over \$1,000.

FTP SOFTWARE INC.

PC/TCP Network Software for DOS

by Paul Ferrill

FTP Software provides one of the most complete TCP/IP solutions for IBM PCs and compatibles. You can order its \$400 *PC/TCP Network Software for DOS* in versions to work with just about any network interface board on the market. Because the software is hardware-independent, FTP's *PC/TCP* is easily integrated into an existing LAN. The products tested for this evaluation were configured for a Western Digital WD8003 Ethernet board.

Installing the *PC/TCP* software is a breeze; the batch file supplied with the software makes it simple. The installation program asks a series of questions about the destination drive and the drive for the *PC/TCP* distribution disk. Once these are answered, the program completes the in-



LAN Workplace for DOS, Version 3.5

Excelan Inc.
2180 Fortune Dr.
San Jose, CA 95131
(408) 434-2300
List Prices: *TCP/IP Transport System*, \$100; *NetBIOS Application Program Interface*, \$50; *HostShare*, \$100; *HostAccess*, \$150; *HostAccess/3270*, \$100; driver for *NetWare/286*, \$25; EXOS 205T Intelligent Ethernet Controller with 268K RAM, \$835.
Requires: 268K RAM, EXOS interface board, DOS 3.1 or later.
In Short: The Excelan solution integrates various software modules onto a proprietary Ethernet board with its own processor. Software options include MS-NET, NetBIOS, 3270 terminal emulation, and standard TCP/IP utility operation. This is a flexible product with many features. If you know which options to order.

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It's virtually impossible to calculate, formulate, and configure the capacity needs for PC LAN hard disks these days.

Introducing Plus Impulse.[™] The world's first expandable PC LAN hard disk system.

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The Impulse system features a 12 millisecond effective access time,[™] an embedded controller with 64 KB of on-board cache and a maximum transfer rate of 4 megabytes per second. Which means an Impulse 40 or 80 MB drive delivers 300 MB drive performance.

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Unless you



one path to 300 MB, Impulse gives you 4 or 8 paths to 320 MB.

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For complete details on this expandable PC LAN hard disk system, just fill out the coupon and send it in. Or call 1-800-624-5545 ext. 207.

We'll tell you everything you need to know about Impulse. Then, we'll send you our free book entitled "A Guide For Specifying Mass Storage Capacity For PC LAN Servers." It's Plus' definitive guide to determining storage capacity for PC LAN servers. And a valuable reference for anyone who has questions about the future of their PC LAN network storage plans. Contact us today.

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1778 McCarthy Boulevard, Milpitas, CA 95035

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know how to add.





FTP Software's \$400 PC/TCP Network Software for DOS is hardware independent and can run with just about any network interface board, making it an easy addition to most existing networks. FTP and SMTP host programs are included.

stallation. One welcome aspect: you can opt to install only a subset of the programs contained on the three 5¼-inch distribution disks.

In order to configure the software properly, the Internet address of the machine must be known, as well as the address of the primary host on the network. These can be changed later using utility programs provided by FTP. Once the software is configured, you have to add two lines to your CONFIG.SYS file.

FTP provides a nice test utility called PING (Packet Internet Groper), designed to contact another node on the network to test the connection. This is done by running an FTP-server program on the other node and then executing the PING program.

The TELNET and FTP programs conform to standards and perform well. FTP Software also includes an SMTP mail program, remote print server programs that

support remote printing on Unix systems, remote file backup, and a number of network-configuration and diagnostic programs.

Because FTP Software includes FTP and SMTP host programs, PCs running FTP Software's version of TCP/IP are not limited to acting as terminals for bigger hardware. The ability to use any machine on the network, including a PC, as an FTP, SMTP, or print server can be very important in complex networks.

FTP Software recently announced a version of PC/TCP that integrates into the LAN Manager environment. Soon, DOS LAN Manager client workstations can concurrently access TCP/IP network hosts and LAN Manager servers. Prior to the introduction of this product, client PCs could run either PC/TCP or LAN Manager, but not both concurrently.

FTP Software sells primarily through OEMs with established distribution channels. Some of their OEMs include Acer, Allied Telesis, Banyan Systems, BICC, Cisco, D-Link, DSC, IMC Networks Corp., Interlan, MCAssociates, Proteon, Schneider and Kock, Scope, Spartacus, Spider, Tiara Computer Systems, Torus Systems, Univision, and Western Digital. The OEMs and FTP Software all provide technical support for these products. FTP Software doesn't provide a direct solution for people who want to integrate with NetWare, but Acer, D-Link, Gateway, IMC, and Interlan combine FTP's software with NetWare drivers for their Ethernet boards. The offerings from FTP are very complete and constitute one of the few hardware-independent TCP/IP solutions on the market.

IBM CORP.

IBM TCP for the PS/2

by Frank J. Derfler, Jr.

IBM has been in the TCP/IP business for a long time. The Department of Defense (DOD) contracted with IBM to develop TCP/IP modules for specific IBM operating systems and hardware several years ago, and today there are IBM products for the VM operating system, the IBM Series/1 minicomputer, and various IBM Token-Ring, PC Network, and Ethernet systems.

The official name of IBM's TCP/IP offering for the PC is *IBM Transmission Control Protocol for the Personal System/2 Computer*. We'll call it *TCP for the PS/2*, but of course it supports the IP protocol, too. (Since ordering lesser-known IBM products is sometimes a challenge, it might be useful to have the IBM order number, which is 5871-AAA.) Order feature 3271 for 3½-inch disks or 3269 if you have 5¼-inch disk drives. The product is reasonably priced at \$195.

TCP/IP for the PS/2 comes in a large three-ring binder. In the back of the binder you'll find either sixteen 5¼-inch disks or eight 3½-inch disks. There are so many disks because IBM gives you the drivers and accessory programs for each board it supports.

IBM tried to make it easy to install the program by providing an installation program and a menu-driven configuration program, but installing this package still isn't a task for the novice. The manual seems detailed, but it has some significant holes.

For example, the manual tells you to

PC FACT FILE

PC/TCP Network Software for DOS, Version 2.03
FTP Software Inc.
26 Princess St.
Wakefield, MA 01880
(617) 246-0900
List Price: \$400; NetBIOS option, \$80.
Requires: 384K RAM, DOS 2.0 or later.
In Short: A complete TCP/IP implementation that comes in versions for many different network interface boards. The software provides more functionality than many other implementations, and a major benefit is that existing interface boards may be utilized to implement a TCP/IP connection.

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PC FACT FILE

IBM TCP for the PS/2, Version 1.0
IBM Corp.
Contact your local authorized IBM dealer.
List Price: \$195 for first package, \$145 for each additional license.
Requires: 256K RAM, IBM Token-Ring or PC Network adapters or specific Ungermann-Bass or 3Com adapters, DOS 3.0 (for Ethernet networks).
In Short: IBM's TCP/IP package carries a low price and a lot of value. The product interfaces with several popular network adapters, includes 3270 terminal emulation, and comes with every practical TCP/IP utility except the ability to use third-party terminal emulators.

CIRCLE 411 ON READER SERVICE CARD



Hatfield.



McCoy.

We had these two talking in no time at all.

Seems like every time these two boys set down together, they commenced to fightin'. If one said day, the other night. Good thing the folks at TOPS settled this feud once and for all. It's so dang simple, too. Just install TOPS software in each Macintosh and PC in the

place. Throw in a network card for each PC. Add a little twisted-pair telephone wire, and suddenly they're behaving like family.

TOPS Tech Specs

- One copy of TOPS software required for each network station.
- TOPS supports AppleTalk and FlashTalk running on twisted-pair cabling (telephone wire), and EtherTalk on thick or thin Ethernet cabling.
- IBM PCs, PS/2 Models 25 or 30, or compatibles require TOPS FlashCard, 3Com EtherLink II or other network card. PS/2 Models 50 through 80, or compatibles require 3Com EtherLink/MC card or equivalent.
- TOPS can be configured as a distributed, dedicated, or combination network.

Next thing you know, they're swapping files, sharing peripherals, and trading data from Lotus 1-2-3 to Excel, dBase III to dBase Mac, and most other PC and Mac applications. Or tapping into whole other networks and systems, such as Novell, AppleShare, Sun, and VAX.

What's more, no central file server is needed—though TOPS can easily accommodate one as a business grows. And no special training is required. No wonder TOPS is the standard for easy-to-use PC to Mac connectivity.

Maybe that's why folks say, when it comes to making connections, TOPS is the real McCoy. Call the TOPS Division of Sun Microsystems at 800-445-TOPS (from outside the U.S. and Canada, call 415-769-8700). Or write 'em at TOPS, 950 Marina Village Parkway, Alameda, CA 94501.

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TOPS®

When you need connections.



CONNECTED WITH SUN



PERFORMANCE TESTS: TCP/IP PACKAGES

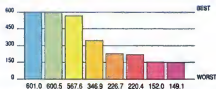
Excelan and FTP Software prove to have the winning combinations when the throughput from a PC to a Sun workstation via TCP/IP is calculated.

Our benchmark tests for these products were simple, but we repeated them many times to get a good average. In these tests, we used a 12-MHz Dell System 200 to communicate with a Sun-3/60 workstation over Ethernet.

Transfer to Sun Workstation

Throughput (kilobits per second)

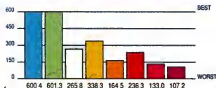
The FTP utility was used to transfer files of 50K and files of over 1MB to the Sun. No local processes were active on the Sun. Times were recorded with a hand-held stopwatch, and the throughputs were computed on the basis of the file sizes.



Transfer from Sun Workstation

Throughput (kilobits per second)

The FTP utility was used to transfer files of 50K and files of over 1MB from the Sun. No local processes were active on the Sun. Times were recorded with a hand-held stopwatch, and the throughputs were computed on the basis of the file sizes.



Product name / Network interface card manufacturer

PC-TCP Network Software for DOS Western Digital

LAN Workplace for DOS Excelan

WBKTCP for DOS Western Digital

PC-ATPS Western Digital

PCSTCP 3Com (3C501)

PCSTCP 3Com (3C505)

PCSTCP 3Com (3C589)

TCP/IP for DOS CMC

Fusion Network Software Western Digital

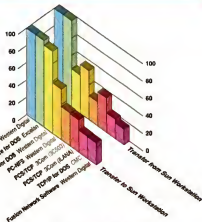


PERFORMANCE TESTS: COMPOSITE VIEW

The differences among the throughput rates of the TCP/IP packages can be attributed to many factors, including the types of Ethernet boards used in various workstations. Note that the boards with their own on-board processors did not group together as the fastest or slowest. This supports our long-held view that the techniques used in creating the driver software are significantly more important in determining throughput than the architecture of the Ethernet card. It is likely that the throughput for any of these systems could have been improved by changing buffer and packet sizes, but we used the default variables in every case.

The real long-term advantage of using Ethernet adapters with their own on-board CPUs (like those sold by Communication Machinery Corp. and Excelan) is that they burden the host CPU less than dumb adapter cards do. The advantage becomes apparent when you run other programs at the same time. As the number of people doing multitasking grows, this capability will become more important. In transferring data to the Sun workstation, Excelan's LAN Workplace for DOS, with its own card, was second in throughput performance to FTP Software's PC/TCP Network Software for DOS, which is a software-only package.

Results for IBM TCP for the PS/2 are not included because our test-bed did not include a Token-Ring-equipped server, and we were not able to complete our tests with the 3C501 Ethernet cards that TCP for the PS/2 supports. We were able to complete the small-file transfers with acceptable throughput results, but the system could not complete file transfers over about 50K.



Relative Throughput
(LAN Workplace for DOS = 100)

CONNECTIVITY

TCP/IP



Priced at just \$195, IBM *TCP for the PS/2* is a surprising bargain among TCP/IP packages. The program comes configured for Token-Ring setups, but it can be modified for a collection of other interface cards as well.

put in the first disk and type INSTALL. Unfortunately, the installation program tries to write a file to a subdirectory called BIN without first creating the subdirectory. The manual doesn't tell you to create the subdirectory, so you are faced with an error message and the DOS prompt when the program dies.

IBM supplies the program configured for Token-Ring. Configuring other supported cards is discussed in the manual,

The late arrival of *TCP for the PS/2* to PC LAN Labs prevented us from arranging for a Token-Ring-equipped server, so we can't comment on the throughput of this software over a Token-Ring network. We installed the software on the older 3Com 3C501 Ethernet cards that *TCP for the PS/2* supports. With this combination of hardware and software, we were not able to complete our performance tests. We could transfer small files to our Sun server over Ethernet with acceptable throughput, but the system could not complete the transfer of files over about 50K in size. We can only assume that IBM's drivers for its own Token-Ring are probably more efficient than its drivers for the old 3Com card.

Despite the low price, IBM gives you a full line of utilities. *TCP for the PS/2* includes both FTP software for file exchanges with host machines and the software for the Trivial File Transfer Protocol (TFTP) that allows PC-to-PC file transfers.

An important part of the IBM TELNET utility is 3270 terminal emulation. Other companies offer this type of emulation as an option, but 3270 operation is a standard part of the IBM TCP/IP package. Also standard in the package is SMTP software that links to IBM's mainframe PROFS mail system (if the right software is running on the PROFS host).

If you use one of the network interface cards supported by IBM's *TCP for the PS/2* and you can forgive some foibles, this product is a bargain (something of a surprise for those familiar with Big Blue's usually daunting price lists). It has an excellent set of features, IBM's logo, and a low price.

Despite the low price,
TCP for the PS/2
includes both File
Transfer Protocol and
Trivial File
Transfer Protocol
software.

but it isn't an easy task. *TCP for the PS/2* is designed to operate on any IBM PC with 256K of RAM. IBM provides drivers for its own Token-Ring and PC Network adapters and for certain Ungermann-Bass and older 3Com Ethernet cards. Interestingly, a dedicated PC with an 80286 or 80386 processor running *TCP for the PS/2* can function as an Internet router. This means that it can move IP-addressed packets among Token-Ring, PC Network, and Ethernet networks.

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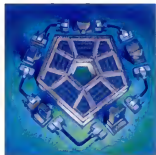
FROM DARPA TO DOD TO MIT TO ARPANET: The Path to the TCP/IP Protocols

by Frank J. Derfler, Jr.

The Defense Advanced Research Projects Agency (DARPA) is a small organization occupying leased office space in the Virginia suburbs a couple of miles from the Pentagon, but its impact on technology in general and data communications in particular has been huge.

In the mid-1970s, DARPA saw the need to link dissimilar computers across the nation to support research efforts. Back then, computers usually used point-to-point leased lines and vendor-specific protocols to communicate. DARPA contracted with several organizations to develop a standard set of nonproprietary communications protocols that would provide easy communications among computers connected in a multinode network. The TCP/IP open protocols that resulted from this effort predate the current work of the International Standards Organization by a decade.

The TCP/IP protocols evolved from work done at MIT and at several companies, as well as from healthy rounds of industry comments. In 1980, DARPA installed the first TCP/IP modules on computers in its networks. It mandated that all computers attached to the growing nationwide ARPANET had to use TCP/IP by January 1983, but



DARPA's planners didn't expect TCP/IP to flourish just because they said it should.

In conjunction with other organizations like the Defense Communications Agency, DARPA contracted with several companies to deliver TCP/IP modules for the computers and operating systems commonly used in government. It also contracted with Bolt, Beranek, and Newman to develop software for Unix machines. This contract allowed universities to obtain TCP/IP inexpensively and to work with the protocols in many different environments. Perhaps most importantly, the Defense Communications Agency began a program of testing and certifying software

for compliance with the DOD TCP/IP standard.

The problem with many products that claim to follow a standard is that they are incomplete. (The "EIA-standard" RS-232C ports on some printers are a good example.) Each designer adds a little twist or leaves out "unnecessary" features to save money or to keep the product unique. The Defense Communications Agency checked and certified TCP/IP products to make sure that they met the standard and really were interoperable. This testing program ended in 1987, but its result was hundreds of products for dozens of computers and operating systems, all of them certified to meet a set of specific standards.

Almost all American universities and federal organizations, as well as many corporations, have taken advantage of the availability and standardization of TCP/IP software. The managers of the TCP/IP program recognize and openly support the International Standards Organization's efforts to develop an extensive set of non-vendor-specific protocols. Plans are in place for TCP/IP to evolve into something called Transport Class 4, or TP4, under the ISO's program, but few people who manage active networks will jump quickly from a tested and proven network protocol to one that is still evolving. TCP/IP has a long and bright future, and best of all, it works well today. ■

ILLUSTRATION: GREG COUCH

NETWORK RESEARCH CORP.

Fusion Network Software

by Paul Ferrilli

Fusion Network Software from Network Research Corp. is a complete TCP/IP package; the \$495 price (\$695 for a special PS/2 version) includes a Western Digital WD8003 interface board. If you don't want the board, you can get the software with drivers for specific Western Digital and 3Com boards for only \$300. While the

entry-level software is plain-vanilla, the price makes this package one of the least-expensive ways to get TCP/IP into a PC. A series of \$50 optional packages add SMTP capability, NetBIOS, network management, programming libraries, and other features.

Physically, installation of the WD8003 board presents no problem to the average user. The board is half-size and can be placed in any open 8-bit slot.

On the software side, we had some problems with NRC's installation program. We had to enter the configuration files and make some changes to the default addresses in order to get the system to run.



FACT FILE

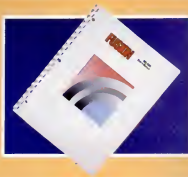
Fusion Network Software, Version 3.2.2
Network Research Corp.

2380 N. Rose Ave.
Oxnard, CA 93030
(805) 485-2700

List Price: \$495 including Western Digital WD8003 Ethernet interface board, PS/2 version, \$695; software only, \$300; optional software modules, \$50 each.

Requires: 256K RAM, DOS 3.0 or later.
In Short: Network Research Corp.'s implementation of TCP/IP provides the basic services, leaving the extras as add-on options.

CIRCLE #12 ON READER SERVICE CARD



Network Research Corp.'s *Fusion Network Software* can be purchased by itself for \$300 or with an 8-bit, half-length Western Digital WD8003 Ethernet interface board for \$495. FTP and TELNET emulation programs are standard.

These procedures were not well documented in NRC's manuals, and it took some telephone hand-holding by the company's tech support staff to make our system operational.

The basic *Fusion Network Software* package provides FTP and TELNET utilities. NRC's TELNET program comes with emulators for both VT-100 and ANSI terminals, though not for VT-220 terminals. NRC also provides menu-driven programs to perform file transfer and remote execution of host commands.

The documentation comes in two 8½-by-11-inch spiral-bound books: the *MS-DOS User's Manual* and the *Network Administrator's Manual*.

Network Research Corp.'s products allow you to configure a TCP/IP installation in many different ways, and that is their biggest advantage. *Fusion Network Software* has many options, and it is appropriate for people who are experienced in Internet installations and want to save money by picking and choosing the parts of the software system they know they'll need.

SUN MICROSYSTEMS INC.

PC-NFS

by Frank J. Derfler, Jr.

Sun Microsystems is best known for its line of high-performance graphics workstations that has proved so popular in computer-aided design, simulation, graphical modeling, and other applications. Sun endorses the philosophy of open computing: its machines use the Unix operating system

and support TCP/IP as a network transport scheme. Sun workstations come ready to communicate on an Ethernet network.

Sun delivers every workstation with a software service called *Network File System (NFS)* as part of its operating system. As its name indicates, *NFS* turns a Sun workstation into a file server for other computers—including PCs—on a network. *NFS* is standard on Sun workstations, and many other companies offer licensed versions of *NFS* for their Unix-based computers. Descriptions of the *NFS* protocols and some sample programs are in the public domain, and anyone with the time and talent can use them to create *NFS*-compatible software.

A \$325 software product called *PC-NFS* implements the Sun *NFS* client software on MS-DOS machines. Under *PC-NFS*, the hard disk on the Sun workstation acts as additional local drives on the PC, and printers attached to the host are available to DOS applications. Since the Sun workstations use TCP/IP to communicate, *PC-NFS* provides a full implementation of TCP/IP, including FTP and other utilities, in addition to the ability to redirect DOS calls to the Sun for service.

Even for those without much expertise in Unix systems, the *NFS* application is easy to activate on a Sun workstation. On the PC side, *PC-NFS* literally installed itself on our Dell System 200 equipped with a 3Com EtherLink II network adapter board. Sun supplies the drivers for all of the 3Com network adapters, the Ungermann-Bass NIU, and Western Digital's popular WD8003E adapter. The only detailed piece of information required to install the application is the name and Inter-

net address of the *NFS*-equipped machine acting as a server. The installation program modifies *CONFIG.SYS* and *AUTOEXEC.BAT* to load the correct drivers and start the redirector.

After the installation session, *PC-NFS* issued a *NET USE* command through a batch file and linked our PC's D: drive to a volume on the Sun's hard disk. The whole operation was quick and very simple. This was particularly impressive considering the power and sophistication of the underlying communications protocols and the server.

When we exercised the *PC-NFS* link, it became apparent that *NFS* won't challenge *NetWare*'s LAN speed record. The layers of software required to ensure compatibility between machines limit the throughput performance. Still, the service provided by *NFS* is fast enough for almost all DOS applications, although performance slowly degrades as more stations load the network and server. The *PC-NFS* service certainly shares data between dissimilar PCs more

The layers of software required to ensure compatibility between machines limit the throughput performance of Sun Microsystems' *PC-NFS* TCP/IP software package.

efficiently than the lower-level FTP utility for TCP/IP.

We ran our LAN performance tests on the *NFS* file server. Once we got all of the file-sharing and operational protocols arranged, everything worked well. *NFS* performance on the Sun is influenced by many factors: the number and type of other applications running on the Sun, the size of the data blocks being transferred, and the configuration of the memory in the server. These configuration factors can be traded off to meet local processing demands.

Because *NFS* links different types of computers, *PC-NFS* comes with some

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CIRCLE 533 ON READER SERVICE CARD



Every Sun Microsystems server supports TCP/IP as a network transport scheme and comes with Network File System (NFS) software. PC-NFS, which costs \$325, installs on PCs connected to a Sun server.



FACT FILE

PC-NFS, Version 3.0
Sun Microsystems Inc.
2550 Garcia Ave.
Mountain View, CA 94043
(800) 821-4643
(415) 960-1300
List Price: \$325

Requires: 512K RAM; 3Com, Ungermann-Bass, or Western Digital Ethernet adapter; DOS 3.1 or later.

In Short: The PC-NFS software uses TCP/IP protocols and its own redirector to make a PC a client of a Sun or Unix computer acting as an NFS host. The package also includes basic implementations of FTP and TELNET.

CIRCLE 413 ON READER SERVICE CARD

in this version of PC-NFS.

We were stumped by the FTP program's inability to link to an FTP host when we entered the Internet address. All the other versions of FTP we tested accepted either an Internet address or a host name. The Sun version of FTP accepts only the host name and then looks in a table for a correlated address. This won't bother most people who use the system, but some programmers and system administrators might address FTP with an Internet address. Sun's technical support people say that this break from standard practice is scheduled for revision.

The full implementation of PC-NFS occupied just over 80K on each workstation. This included both the NFS redirector and the TCP/IP elements and utilities.

When PC-NFS-equipped PCs are used with non-NFS servers, they lack some of the flexibility of other TCP/IP implementations. For instance, there is no ability to act as an FTP host or to use other terminal emulators with TELNET. But those minor limitations quickly fade when a PC running PC-NFS talks to an NFS host. The ability to use practically any Unix machine as a true file server under NFS is an important step in the integration of PCs and minicomputers in workgroup environments.

3COM CORP.

PCS/TCP

by Frank J. Derfler, Jr.

TCP/IP is important to 3Com Corp; the marriage between Bridge Communications and 3Com added strong TCP/IP expertise and products to 3Com's PC-based

networking line. More recently, 3Com and Hewlett-Packard announced that they will codevelop interoperable systems based on TCP/IP technology.

3Com markets four different products that bring TCP/IP services to the PC. Two of the products are designed to coexist with the Xerox Network System (XNS) protocol stack. We don't have an XNS server, so we didn't test these products, but the other two fit nicely into our test-bed.

3Com is the one company offering both a hardware-based TCP/IP product and a software-based package. The \$295 software product, PCS/TCP, comes with drivers only for 3Com EtherLink and Token-Link adapter boards, but these boards are so popular in the market that this isn't a big limitation. The \$1,195 PCS/I package includes slightly different software and its own microprocessor-equipped network adapter card.

The network adapter used in the PCS/I package is called ILANA (Intelligent LAN Adapter). Its features are very similar to those of the other smart boards: Motorola 68000 processor, 8-MHz operation, and 512K of on-board RAM for the 68000. The TCP/IP core software downloads to the 68000, so the drivers loaded in CONFIG.SYS don't make a big impact on standard RAM.

A program on the PCS/I disk called SETUP loads files into a subdirectory and modifies the CONFIG.SYS and AUTOEXEC.BAT files. The author of this program was thoughtful enough to relabel the original versions of these programs with an .OLD extension.

The PCS/I software package includes FTP and TELNET; NetBIOS and 3270 terminal-emulation features are optional. 3Com's FTP has the standard features, but the company provides CONNECT, a very



FACT FILE

PCS/TCP, Version 1.0
3Com Corp.
3165 Kifer Rd.
Santa Clara, CA 95052
(408) 562-6400

List Price: PCS/TCP, \$295; PCS/I board, \$1,195; network license, \$1,525; PCS/NetBIOS, \$100; PCS-3270 terminal emulation, \$100.

Requires: 256K RAM, DOS 3.1 or later
In Short: The PCS/TCP software package runs on 3Com's Ethernet and Token-Ring adapters. The PCS/I package includes an enhanced TELNET package, but PCS/TCP alone is an excellent value.

CIRCLE 414 ON READER SERVICE CARD

unique utilities that translate between operating systems. One utility converts ASCII files between the DOS and Unix formats. Another displays the MS-DOS filename next to the NFS filename if they are different. If you are using a PC but are more comfortable with Unix commands, PC-NFS recognizes Unix management commands for directory and network status reports.

Together, NFS on the host and PC-NFS on PCs provide a strong network environment system. The PC benefits from the large storage capacity on the Sun and from the ability to share data files between Unix and DOS applications.

The PC-NFS package includes the standard lower-level TCP/IP utilities in addition to the NFS redirector software. FTP and TELNET are available for communicating with computers that are not NFS servers. The TELNET package includes a VT-100 terminal emulator, and FTP gives the capability for file transfers with an FTP host. No NetBIOS emulation is provided



TCP/IP PACKAGES: SUMMARY OF FEATURES

(Products listed in ascending price order)	Excelan Inc. LAN Workplace for DOS	IBM Corp. IBM TCP for the PS/2	3Com Corp. PCS/TCP	Communication Machinery Corp. TCP/IP for DOS	Network Research Corp. Fusion Network Software	Sun Micro- systems Inc. PC-NFS	PC The Watlington Group WIN/TCP for DOS	FTP Software Inc. PC/TCP Network Software for DOS
List price (software component)	\$100	\$195	\$295	\$300	\$300	\$325	\$395	\$400
FILE TRANSFER PROTOCOL (FTP)								
FTP utility included	●	●	●	●	●	●	●	●
FTP host software included	●	○	●	○	●	○	●	●
TERMINAL EMULATION/COMMUNICATIONS								
TELNET utility included	●	●	●	●	●	●	●	●
TELNET software emulates VT-100 terminals	●	●	●	●	●	●	●	●
TELNET software emulates VT-220 terminals	●	●	○	●	○	○	○	●
Terminal emulators use Interrupt 5bh for TELNET interface	●	○	●	●	○	○	○	○
Terminal emulators use Interrupt 14 for TELNET interface	●	○	○	●	○	●	●	○
SIMPLE MAIL TRANSFER PROTOCOL (SMTP)								
SMTP software included	○	●	○	●	●	○	●	●
SMTP PC host software included	○	●	○	○	●	○	○	●
OTHER								
NetBIOS Interface included	●	○	Optional (\$100)	●	○	○	○	Optional (\$60)
NetWare IPX protocol drivers included	●	○	○	●	○	○	●	○
User can hotkey between TCP/IP and NetWare without rebooting	●	○	●	●	○	○	○	○
Software downloads to network interface card with processor	●	○	●	●	○	○	○	○

■ —Editor's Choice ● —Yes ○ —No

enhanced version of TELNET with PCS/1. CONNECT includes XMODEM and KERMIT file-transfer capabilities, as well as a special documented application program interface; this API lets third-party developers write programs that directly address the communications package. CON-

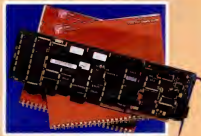
NECT accepts the *SmartTerm* and *Reflection* terminal-emulation packages, which provide HP, DEC, and Data General terminal emulation.

We didn't test the TCP/IP programs for multitasking compatibility, but 3Com stresses the ability of its software to run un-

der Quarterdeck Office Systems' *DESQview* or *Microsoft Windows*. Using these multitasking programs, you can switch from one connection or program to another—for instance, switching among separate Novell *NetWare*, 3Com *3+Share*, and TCP/IP sessions.

We ran the 3Com *PCS/TCP* software over 3Com's popular *EtherLink II* adapters. The package doesn't include the enhanced CONNECT program that comes with the PCS/1 product, and the TELNET implementation you get is plain-vanilla. Overall, though, this package occupies slightly less RAM and has nearly the same maximum throughput as the PCS/1. This reflects well on the drivers that 3Com provides for its boards.

Again, the value of processor-equipped adapter cards like the ILANA isn't as much in their throughput as in their ability to off-load the host processor. In a multi-function environment, the PCS/1 should



PCS/TCP is the software component of 3Com's \$1,195 PCS/1 package, which also includes an Intelligent LAN Adapter card with its own 68000 processor and 512K RAM. The on-board memory relieves the PC's memory from network drivers.

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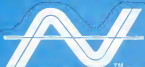
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☐ **INDIVIDUAL CREDIT**. Complete sections "a" and "b" only.

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Requested Line of Credit \$

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State of Residence: Month _____ Year _____		Monthly Payment: \$ _____		Day _____ Night _____ Other _____	
Previous Address: _____		Date of Residence: _____		From _____ To _____	
Your Employer: (If self-employed, see next panel) _____		Date of Employment: Mo _____ Yr _____		Position _____	
Employer's Address: Street _____ City _____ State _____		Business Phone: _____		Net \$ _____	
Previous Employer: _____		Address: _____		Date of Employment: From _____ To _____	
Income from salary, child support or spouse's income (if you are not self-employed) _____		Other Income: _____		Monthly Income: Gross \$ _____ Net \$ _____	
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Name and Address of Nearest Relative Not Living With You: _____					

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Bank Account: _____		<input type="checkbox"/> Checking <input type="checkbox"/> Savings	
Bank Loan Reference: _____		Payment _____ Balance _____	
Bank Card Reference: <input type="checkbox"/> VISA <input type="checkbox"/> Mastercard			
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Driver's License No. _____ State _____		Expires: _____	

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Address: Street _____ Apt. # _____ City _____ State _____ Zip _____		Home Phone: _____			
Employer: _____		Date of Employment: Mo _____ Yr _____		Position _____	
Employer's Address: Street _____ City _____ State _____		Business Phone: _____		Net \$ _____	

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Complete this section only if you are self employed.

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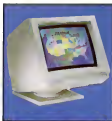
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continue to operate with little degradation, but the throughput of the *PCSTCP* package running on a "dumb" Ethernet card will slow down.

It isn't fancy, but for the large number of people with 3Com cards the *PCSTCP* package provides a relatively inexpensive, fast, and efficient TCP/IP alternative.

THE WOLLONGONG GROUP

WIN/TCP for DOS

by Frank J. Derfler, Jr.

Wollongong is an Australian aborigine term meaning "beautiful place by the sea." *WIN/TCP for DOS*, marketed by The Wollongong Group, tries to make your LAN a beautiful place (if not by the sea) with a complete and flexible product that is easy to install and use.

WIN/TCP for DOS supports a wide variety of Ethernet network interface boards through customized drivers, Token-Ring NetBIOS drivers, or *NerWare* IPX drivers. Drivers for Western Digital, Novell, and 3Com boards come in each package. The *WIN/TCP* package also includes software supporting the Serial Line Interface Protocols (SLIPs). SLIP software lets you send TCP messages out the serial ports on a PC for connection to a remote host. *Wollongong* has TCP/IP solutions for practically every type of network retrofit or new installation.

The \$395 *WIN/TCP* package includes the TCP, TELNET, and SMTP utilities and all of the network and SLIP drivers. You don't have to order a separate version for each hardware configuration. In addition to the standard set of utilities, *WIN/TCP* also includes programs to exercise the TCP/IP network, manage remote printers through TCP/IP, and access remote users' directories. A NetBIOS emulator is not included as part of *WIN/TCP*, but because of the unique configuration of this product, NetBIOS services are often still available on networks.

The relationship between *WIN/TCP* and NetBIOS requires a little explanation. The standard concept of NetBIOS software is as an application-program interface sitting above TCP and the User Datagram Protocol (UDP). In this concept, programs such as file-server and e-mail packages make standard NetBIOS calls that pass to TCP/IP or other transport-layer software for service. The *WIN/TCP* pack-

age includes the software to do this, but to gain flexibility, *Wollongong* also includes a version of TCP that sits on top of and interfaces NetBIOS or Novell's IPX. This upside-down arrangement gives *WIN/TCP* the ability to work with Token-Ring and other network adapters that typically don't have TCP/IP services available.

The configuration of *WIN/TCP* as an "up top" module makes it easier to use with Novell *NerWare* than any of the other TCP/IP implementations. Instead of being compiled into *NerWare* when the networking software is installed, the *WIN/TCP* driver for IPX sits on top of IPX and uses its services. Everything stays simple. Because IPX is unchanged, you can design a workstation software system that lets people move quickly between a pure TCP/IP Ethernet session and a *NerWare* session without rebooting. You can also install TCP/IP services on an existing Novell LAN without recompiling the *NerWare* workstation shell.

In theory, the upside-down configuration of *WIN/TCP* over Novell's IPX should give it slower performance than drivers that are compiled into the *NerWare* shell. We did not test all of the *NerWare* configurations, but in a few comparative tests we saw surprisingly little difference in performance. *WIN/TCP* was near the top of the pack in performance doing pure TCP/IP file transfers with the Sun workstation and Dell System 200 PCs in our network test-bed.

Wollongong's installation program copies the correct files to the hard disk and modifies the CONFIG.SYS file. The installation is simple, but if you want to customize programs such as the TELNET VT-100 emulator, *Wollongong* gives you



FACT FILE

EDITOR'S CHOICE

WIN/TCP for DOS, Version 4.0

The Wollongong Group
1129 San Antonio Rd.
Palo Alto, CA 94303
(415) 962-4374

List Price: \$395

Requires: 384K RAM, DOS 3.1 or later.
In Short: *WIN/TCP* is a flexible implementation of TCP/IP for the PC that easily integrates into NetBIOS and Novell networks and is supplied with drivers for many Ethernet boards.

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the ability to do so. You can run terminal-emulation programs with interrupt 14 service, such as *Reflection* or *Crosstalk Mk.4*, on top of FTP.

Wollongong also provides a utility to unload the major section of code from RAM if you want to stop using TCP/IP and free up RAM space. About 14K of driver software loaded by CONFIG.SYS stays in RAM, but the majority of the software will unload.

Other *Wollongong* utility programs exercise the network by generating automatic queries and responses and help find users on a network. *Wollongong* includes an FTP Server module that allows PCs to act as FTP servers. Because of the power available in today's 80386-based PCs, it is increasingly important (and increasingly feasible) to have FTP server software available at the PC level.

Wollongong supplies excellent documentation. Separate installation and operation manuals provide detailed information covering the core TCP/IP software and the utilities.

Because of its flexible and pragmatic



The Wollongong Group's \$395 *WIN/TCP* for DOS software

package offers customized drivers that support a good selection of Ethernet interface boards, and a unique arrangement of communications protocols builds in great flexibility.

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CONNECTIVITY

TCP/IP



EDITOR'S CHOICE

• The Wollongong Group
WIN/TCP for DOS

There are two categories of products that bring TCP/IP to the PC: those that run only with their own network interface boards and those that run on a variety of interface adapters. The differences between these approaches are seen mainly in pricing and in the amount of RAM that remains available to DOS. The fact that cards with on-board processors don't load the host computer's processor can be significant, but much of the advantage of the proprietary boards is lost in state-of-the-art installations because you can unload utilities or use third-party memory-control products to release most of the RAM when you aren't using the TCP/IP products.

The package with the most features, flexibility, and value is The Wollongong Group's WIN/TCP for DOS. The Wollongong Group provides all the options, including NetWare support and drivers for common Western Digital and 3Com cards, in one package at a fair price (\$395).

If you don't need NetWare integration but you do need NetBIOS, PC/TCP Network Software for DOS from FTP Software is a good alternative to Wollongong's product. It produced the fastest throughput times in testing.

If you want a package that comes with its own hardware, the best option is Excelan's LAN Workplace for DOS with the EXOS 20ST Interface Board. This combination was the second-best performer in testing.

approach to system structure, we like the way Wollongong brings TCP to the PC. WIN/TCP for DOS provides good solutions for most PC and TCP integration problems. ■

Frank J. Derfler, Jr., is workgroup systems editor of PC Magazine. Paul Ferrill is an electrical engineer with a wide range of experience in micro- and minicomputer systems.

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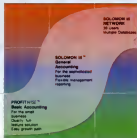
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by
Douglas Boling

Utilities

If you've got an AT-style machine with extended memory (RAM above 1MB) but you haven't got an expanded (LIM/EMS) memory board and its associated driver software, you are not taking full advantage of your machine's potential. Apart from a few RAMdisks and caches, there's very little DOS software that can use your extended memory.

For the fastest performance there's no alternative to getting a dedicated EMS board and a second mortgage. But if you just want to access those big, memory-busting Lotus 1-2-3 spreadsheets on your AT, and you're willing to trade some speed for the ability to use the extended memory you've already got, EMS40.SYS is your answer.

EMS40.SYS is a device driver that makes extended memory look like expanded memory. In today's jargon, a software emulator such as EMS40.SYS is often called a *LIMulator*. It's a software implementation of the 28-function standard set forth in the Lotus/Intel/Microsoft Expanded Memory Specification (LIM=EMS), Version 4.0. All of the EMS 4.0 functions that can be implemented through software are provided by EMS40.SYS, with the exception of the DMA functions included in the Alternate Map Register Set function, function 28.

EMS40.SYS is backward-compatible with software written for the earlier 3.2 LIM/EMS standard, and also it lets you specify that only a portion of your machine's extended RAM be used as expanded memory. If you already use an extended-memory program such as VDISK, you can configure it to use as much or as little of your machine's extended memory as you wish.

The easiest way for you to get a copy of the EMS40.SYS program is to download it from PC MagNet, as explained in the sidebar "EMS40 by Modem." If you don't have a modem, the assembly language source code is printed here, as is a BASIC program that will also let you create a copy of EMS40.SYS. Both EMS40.ASM and

**EMS.SYS EXPANDS
EXTENDED MEMORY:**
Living within 640K is
getting harder every
day. If you've got
extended memory
that's only good for
VDISK programs,
here's how to make it
emulate the more-
useful EMS 4.0
expanded RAM.

EMS40.BAS are available through PC MagNet.

You install EMS40.SYS just as you would any other DOS device driver, through your CONFIG.SYS file. In listing the entry there, be sure to include any necessary drive and path information DOS will need to find the driver at boot-up. The full syntax for EMS40.SYS is

```
DEVICE=[d: \] [path \] EMS40[.n] .SYS [nnn]
```

The optional *nnn* is a memory parameter that you can enter to specify the number of kilobytes of extended memory you want to use as expanded RAM. If the *nnn* parameter is omitted, EMS40 uses a default value of 384K. As with all device drivers, once EMS40.SYS has been installed (during boot-up) it can be removed only by rebooting. To make its installation optional, see Michael J. Mefford's CONFIG.CTL,

which was published in the November 29, 1988, Utilities section.

The EMS40.SYS driver logically maps extended-memory "pages" (16K blocks) into four contiguous, physical pages of conventional RAM. Including the 64K physical page map area, the installed size of the driver is approximately 69K. EMS40.SYS can't map extended-memory pages to other than the four pages it allocates automatically on boot-up.

In the tests I have run, EMS40.SYS has proved compatible with all other programs that use extended memory. If you encounter any problems with other device drivers, try placing EMS40.SYS first in the CONFIG.SYS file. The sidebar "Extended-Memory Management" shows how EMS40.SYS reserves extended memory.



IN-LINE CODE



This issue introduces a new treatment of in-line code. From now on, we will tint *every other line* of code so you can easily distinguish one *complete* line of code from the next. If what should be a single-line entry on-screen is shown on two lines in the magazine, both lines will receive the same tint treatment. In addition, the number of spaces a secondary line is indented will indicate the number of spaces you should include when typing that multiple-line listing as a single-line entry on-screen. If a line is not indented, do not include any spaces.

Utilities

EXTENDED AND EXPANDED

Before explaining the internal aspects of EMS40.SYS, it is important to review some memory fundamentals and to under-

stand the differences between extended and expanded memory.

The amount of memory any microprocessor can access directly is entirely dependent on the number of address lines on the chip. The 8088 CPU used by the IBM PC has 20 address lines. This means that the total memory it can address is two

raised to the twentieth power (2^{20}), or 1,048,576 bytes. The PC's 8088 microprocessor thus imposes an addressable size limit of 1MB.

Within its 1MB hardware limit, the original PC was designed to provide programs with up to 640K of RAM. Memory space first had to be allocated for the ROM

EXTENDED-MEMORY MANAGEMENT

by Douglas Boiling

There are a number of reasons why trying to use extended memory can be intimidating. Not the least of these is the absence of a set of rules for extended-memory management. Without them, the only way to remain compatible with other programs is to act as they do. Fortunately, only a few DOS programs use extended memory.

For years the only programs that used extended memory were RAM-disks, the most prominent being VDISK, which comes bundled with DOS. The introduction of the PS/2 series brought with it IBMCACHE, a disk-caching program that also uses extended memory. VDISK and IBMCACHE take very different approaches to extended-memory management. Figure A illustrates both programs using extended memory.

IBMCACHE checks the amount of extended memory available and assigns itself as much extended memory as it needs from the top of the address space. It then intercepts the Get Extended Memory Size function of BIOS and thereafter reports the existence of only the memory not in use. Thus, another program wishing to use extended memory would first call the Get Extended Memory Size function. Seeing only the

extended memory not used by IBMCACHE, a program would not use the memory IBMCACHE has reserved.

In contrast to the simple IBMCACHE method of reserving extended memory, the DOS VDISK driver uses a complex, program-specific operation.

When the VDISK driver is initialized, it checks to see if another VDISK driver has previously been installed. If no other VDISK is present, the driver determines the amount of expanded memory it needs and then sets a pointer at the first byte of extended memory that is



EXTENDED MEMORY MANAGEMENT BY IBMCACHE AND VDISK

IBMCACHE uses memory from the top of memory, while VDISK uses memory from the bottom up.

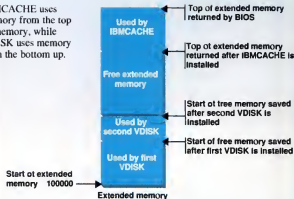
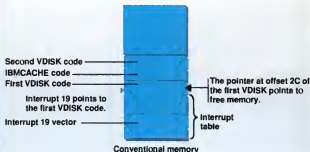


Figure A: This figure shows how two VDISK programs and IBMCACHE work together to reserve extended memory. VDISK uses memory starting at the lowest extended-memory address and sets a pointer at the first free byte above its own reserved area. IBMCACHE and EMS40 use memory from the top of memory down by intercepting the Get Extended Memory Size function of BIOS. Such programs then protect their own memory area by telling other programs that a smaller amount of extended memory is installed than is actually the case.



BIOS and the video memory, with a bit to spare for future contingencies. This done, the remaining 640K was assigned to DOS and its programs. At the time, 640K—referred to as “conventional” memory—was thought to be more RAM than anyone could ever want. It was fully ten times the maximum available to the then-competing

beyond the reserved memory.

VDISK uses the interrupt 19h vector to indicate that it has been installed. VDISK redirects the interrupt 19h vector to a dummy routine within the driver. The dummy routine simply passes on any call to interrupt 19h, but by pointing to the VDISK code segment, other drivers can check to see if the interrupt 19h vector points to a VDISK driver. Since interrupt 19h is the BIOS boot interrupt, there is no reason for other device drivers to change this particular vector.

When the first VDISK has determined how much extended memory it needs, it saves the address of the first byte of free memory at offset 002Ch in its code segment. When a second VDISK driver is initialized, the later VDISK scans the segment pointed to by the interrupt 19h vector. If the VDISK header is found, the driver reads the address of the free memory beyond the extended memory reserved by the first VDISK. The second VDISK then reserves the memory it needs by adjusting the pointer in the code of the first VDISK. This way, any future VDISK drivers that are initialized will read the modified pointer from the first VDISK, a helpful feature.

Clearly these two methods of reserving extended memory are very different. Unfortunately, since both programs are in wide use today, both must be taken into account if a program is to use extended memory. The simpler of the two, the IBMCACHE method, is the one used by EMS40. By simply indicating that there is less extended memory than is actually present, EMS40 can reserve as much extended memory as it needs without the nagging worry of future compatibility difficulties. EMS40 does check for a VDISK driver using the interrupt 19h method, but only to make certain that it does not attempt to access memory used by VDISK. ■



COMPARING PC AND PC AT MEMORY MAPS

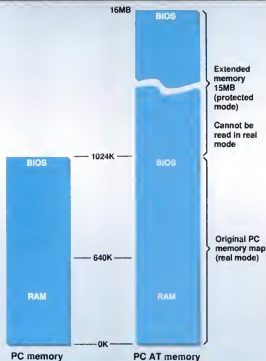


Figure 1: As shown here, the memory map of the original PC and of the PC AT are the same below the 1MB point. Memory above the 1MB limit is extended memory, but even programs running in real mode on an AT cannot directly access it.

8080-based machines.

It turned out, however, that Parkinson's Law applies also to computers: "Programs expand to fill available memory." Everyone wanted programs with more features, DOS itself got bigger, and TSR utilities became popular. The 1MB hardware barrier was finally broken by the introduction of the PC AT machine, whose 80286 microprocessor has 24 address lines, allowing it to address 16MB (2^{24}). Figure 1 shows the difference between the original PC memory layout and the AT's extended memory map.

While the AT's 80286 CPU could address 16MB, accessing the extra 15MB of "extended" memory required the processor to operate in its protected mode. Protected-mode operation is incompatible with DOS. A new operating system, which would have made existing software

obsolete, would have been required. And at the time the PC AT was announced, the DOS marketplace had grown so large that compatibility became the decisive consideration.

Thus, even though the AT could access it, IBM did not provide any substantial support for extended memory. Acknowledging the potential use of this memory, IBM did at least include minimal support—in the AT BIOS—for moving blocks of data to and from extended memory. Unfortunately, IBM did not provide for even such basic necessities as memory management to prevent conflicts between extended-memory programs. Without any rules to guide them in the proper use of extended memory, software manufacturers have allowed it to lie fallow ever since. [Note: XMS, a specification for extended memory, was recently introduced. See

Utilities

Ray Duncan's Power Programming column in this issue for details of the specification as well as for a more-detailed discussion of extended-memory usage.]

Recognizing the need for more memory—and with a view toward selling new products—memory board manufacturers adapted an alternative approach to expanding available memory space. They implemented a time-proven, though perhaps inelegant, technique known as "paging," or "bank-switching," memory. With no protected-mode DOS on the horizon, this was the only game in town, so software developers joined in. The result became known as the Lotus/Intel/Microsoft Expanded Memory Specification (mentioned above). With the release of Version 4.0 of this specification, previously competing im-

plementations of paged memory were joined under one standard that allows access to up to 32MB of expanded memory. With these new standards came more use. The additional address lines of the 80286 chip made expanded memory possible, and the new Expanded Memory Specification has made use of memory beyond 1MB feasible.

The key to expanded memory is the concept of paged memory. In a paged-memory system, the computer uses an extra register (known as a page register) to allow the same address to "map" or point to many different actual addresses in memory. To retrieve a specific byte becomes a two-step process: the program first sets the page register to access the correct section of memory, then reads the byte as it normally would. At any given time the page register determines which page of memory addresses will actually be mapped into the readable area of memory, and the number

of pages that can be mapped is limited by the size of the page register.

Because the mapping of the total memory by a single page register is not very flexible, paged-mode systems divide the conventional memory map into smaller sections. By using a page register for a section in memory, a paged-mode system can address many different pages at the same time in different sections of memory. This makes it possible for conventionally addressed memory and paged-mode memory to coexist.

Admittedly, the paged-mode part of the EMS 4.0 specification is more flexible

The memory management features provided under EMS, Version 4.0, are extensive. In order to use expanded memory, a program must first request the memory from the EMS driver.

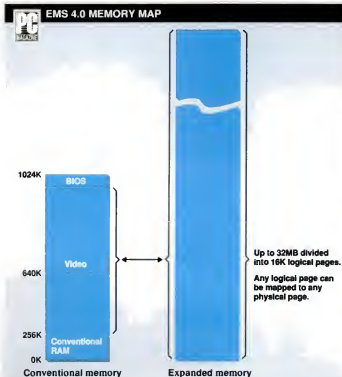


Figure 2: The illustration above shows how a 16K page of expanded memory can be mapped into the conventional-memory space of the PC. An EMS physical page can be positioned logically in any empty memory space between 256K and 1024K.

than a software emulation such as EMS40.SYS can fully realize. In EMS 4.0, expanded-memory pages can be mapped into any of the empty 16K portions of the physical memory space between 256K and 1MB. The EMS40.SYS program, like the earlier 3.2 LIM specification, assigns its 16K physical memory pages contiguously in conventional memory. Figure 2 shows a diagram of the expanded-memory model.

The EMS 4.0 specification implements more than just a paged-memory design; it also provides a method for managing the additional memory. Thrown in for completeness are methods for programs to communicate with each other, context saving so programs can execute concurrently, and operating-system management of the expanded memory.

The memory management features pro-

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Utilities

vided under EMS, Version 4.0, are extensive. To use expanded memory, a program must first request the memory from the EMS driver. Once that is allocated, a program can request that a page be mapped into memory so that it can be used. Expanded memory can then be used like conventional memory, except that it should not be allocated for stack space.

INSIDE EMS40.SYS

If all EMS40.SYS had to do was to implement a paged-mode memory scheme, it would have been an easy program to write. A quick peek at the source code indicates that the EMS40.SYS program does a lot more than map pages; it tries to implement all of the many features of the EMS 4.0 specifications.

As with any large programming task, the way to tackle this problem is to subdivide it into smaller tasks. EMS40.SYS is simply a collection of routines designed to implement the 28 functions of Version 4.0. Aside from a subroutine for each function, a few support subroutines are used to provide general services to the driver. One of the support routines is the routine that moves data to and from extended memory. It is this routine that provides an instructive example of how to program for the growing segment of 80286-powered machines.

Since DOS uses the real rather than the protected mode of the 80286, memory above 1MB cannot be addressed directly. Programs can access this memory in one of two ways. One way is to switch the processor into protected mode and read the data directly. There are, however, major problems involved if you try to use protected-mode subroutines from within a DOS program. Once in protected mode, a program can't use any of the BIOS routines, nor can it use the services provided by DOS. A new interrupt table must be built and all interrupt routines must be rewritten for protected mode.

If this weren't enough to deter even an adventurous programmer, a final problem looms for those who wish to use protected mode. While the AT BIOS provides a BIOS function for changing to protected mode, there is no corresponding BIOS call to get you back. As part of its commitment to ensuring data integrity, the 80286 provides no way for a program to return to real

A quick peek at the source code indicates that EMS40.SYS does a lot more than map pages; it tries to implement all of the many features of the EMS 4.0 specifications.

mode from protected mode.

To work around this mechanism, IBM had to design into the original PC AT a way in which the processor could actually be stopped and restarted in order to return to real mode. Unfortunately, since IBM did not fully document this function, its implementation is not consistent across the spectrum of AT-style machines on the

market today. Here again, the lack of a documented standard has proved an impediment to those who wish to use extended memory. It is interesting to note that OS/2, which operates in protected mode, must provide its own BIOS functions, since the BIOS on the AT and XT/286 machines can't support protected mode. This is one of the reasons for the large size of the OS/2 operating system.

The simplest way to access extended memory data is to use the BIOS Move Block function, interrupt 15, function 87h. Because this function requires that a global descriptor table be built, its use may initially be intimidating to the casual programmer. Fortunately, the function is actually easy to use.

The global descriptor table is needed because, as we have seen, the processor is temporally switched to protected mode to move the data. As the name implies, the global descriptor table is a table of segment descriptors. Each descriptor describes the contents and size of a protected-mode segment. For the Move Block function, all but the source and target descriptors are initialized to zero.

Figure 3 shows the format of a Move Block call, including the layout of a descriptor entry. The first word, the segment size, specifies the size (up to 65,536 bytes) of the protected-mode segment. The next 3



LAYOUT OF BIOS MOVE

AH = 87h

CX = Number of words to move

ES:SI = Pointer to global descriptor table

Dummy Init. to 0
Data segment Init. to 0
Source descriptor
Target descriptor
BIOS code Init. to 0
Stack segment Init. to 0

Global descriptor table

Segment size
Low word of address
High word of address
Descriptor byte
Reserved

Source and target descriptor format

Figure 3: The BIOS Move Block function enables programs to transfer blocks of data from conventional memory to expanded memory and back. ES:SI points to the global descriptor table. Each entry in the table describes the position, size, and access rights of a protected-mode segment. At the time of this function call, only the source and target descriptors need to be initialized.

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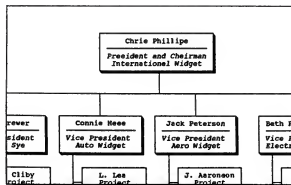
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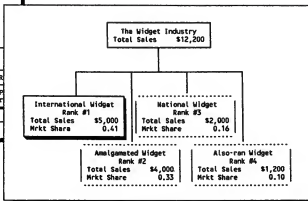
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EMS40.ASM

```

=====
XOR    AX,AX
ADD    $11,EBP
MOV     ESI,EBP PTR [ESI],0 ;see if
JNE     EMS_00_01
MOV     ESI,ESI
JNE     EMS_00_01
MOV     SI,DI
MOV     JPC SHORT EMS_00_03
;if so, copy address

EMS_00_01:
CMP     [ESI],DX
JNE     EMS_00_02
MOV     AH,DX
MOV     JPC SHORT EMS_00_EXIT
;ashold already used for save

EMS_00_02:
LOOP    EMS_00_01
MOV     AH,0CH
MOV     JPC SHORT EMS_00_EXIT
;loop back if less than 4 times
;no room to store page map

EMS_00_03:
PUSH    CX
POPCOUNT
;point said to page array

EMS_00_EXIT:
PUSH    CX
POPCOUNT
;point said to save array

=====
ASSUME CS:CODE
MOV     SI,MAP_ARRAY_PTR
MOV     CX,9
REP     MOVSB
XOR     AX,AX
;clear return code

EMS_00_EXIT:
POP     DX
POP     CX
RET
ENDP
=====
;Function 1. Get handle page
=====
PROC    NEAR
ASSUME CS:CODE,DS:CODE,ES:NOTHING
PUSH    SI
PUSH    DX
JC       EMS_09_EXIT
;carry set, invalid handle

;find the saved page map to the save array.
MOV     SI,MAP_ARRAY_PTR
MOV     CX,2
ADD     SI,18
CMP     [ESI],DX
JE       EMS_09_01
LOOP    EMS_09_01
MOV     AH,RET
MOV     JPC SHORT EMS_09_EXIT
;no saved page map found

;Now that the saved array has been found, call restore map routine.
EMS_09_01:
MOV     SI,SHORT PTR [ESI],0
CALL    EMS_15_1
XOR     AX,AX
;clear return code

EMS_09_EXIT:
POP     DX
POP     CX
RET
ENDP
=====
;Function 12. Get Handle Count
=====
PROC    NEAR
ASSUME CS:CODE,DS:CODE,ES:NOTHING
MOV     DI,HANDLE_ARRAY
XOR     SI,SI
MOV     CX,8X
MOV     JPC HANDLE_ARRAY
;point to handle array
;clear count and compare register
;compute handle to table
;if handle id = 0 then
; handle has not been

EMS_12_01:
CMP     SI,[DI]
JE       EMS_12_01
;allocated.

EMS_12_01:
INC     SI
INC     DI,9
LOOP    SHORT EMS_12_01
MOV     AX,AX
;Add one to open handle count
;Move di to point to next id.

EMS_12_EXIT:
RET
;clear return code

=====
;Function 13. Get Handle pages
;entry dx = handle to search for
;Exit: ax = return code. bx = number of matches found.
=====
PROC    NEAR
ASSUME CS:CODE,DS:CODE,ES:NOTHING
PUSH    SI
JC       EMS_13_EXIT
MOV     SI,MAP_OWNER_TBL
MOV     CX,TOTAL_PAGES
MOV     JPC TOTAL_PAGES
;clear page count

EMS_13_LOOP:
JNE     EMS_13_SKIP
INC     SI
INC     DI,9
LOOP    SHORT EMS_13_LOOP
MOV     AX,AX
;increment active pointer
;have we check all handles?
;no, loop back.
;get number of active handles
;clear return code

EMS_13_EXIT:
RET
ENDP
=====
;Function 14. Get Handle Pages
=====
PROC    NEAR
ASSUME CS:CODE,DS:CODE,ES:NOTHING
PUSH    DI
XOR     SI,SI
MOV     CX,8X
MOV     JPC SHORT EMS_14_LOOP
;handle currently being checked
;total open handles counter
;see if handle active
;return number of pages for bdi
;if had handle, add up
;add to handle count
;write results to the array

EMS_14_01:
INC     SI
INC     DI,DI
MOV     JPC [DI],SI
INC     DI
MOV     CX,9
CMP     DI,TOTAL_PAGES
JNE     EMS_14_01
MOV     SI,SI
XOR     AX,AX
;point to next handle
;increment active pointer
;have we check all handles?
;no, loop back.
;get number of active handles
;clear return code

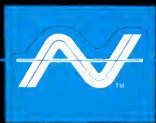
EMS_14_EXIT:
RET
ENDP
=====
;Function 15. Get/Set Page Map
=====
PROC    NEAR
MOV     OFFSET EMS_15_0 ;jump table for subfunctions
=====

```

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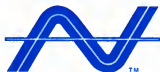
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CALL     EMS_DEALLOC
JMP      SHORT EMS_18_EXIT
ENDP

;=====
;Function 19: Get/Set Handle Attribute (NOT Supported)
;=====
PROC      NEAR
ASSUME   CS:CODE,DS:CODE
CMP      AL,1
JE       EMS_19_1
;Set handle attribute.
;For subfunctions # and 2,
;return volatile handle
; non-volatile not supp
MOV      AX,AX
RET

EMS_19_000_EXIT:
JMP      SHORT EMS_19_EXIT

EMS_19_EXIT:
CALL     EMS_CHECK_HDL
;see if good handle
JNC      EMS_19_ERR0
;see if legal attribute type
; or if non-volatile.
CMP      BL,1
JL       EMS_19_ERR0
JL       EMS_19_GOOD_EXIT
;function not supported
MOV      AX,0
JMP      SHORT EMS_19_EXIT

EMS_19_ERR0:
MOV      AX,0
JMP      SHORT EMS_19_EXIT
;subfunction invalid

EMS_19_ERR2:
MOV      AX,0
JMP      SHORT EMS_19_EXIT
;invalid handle

EMS_19_ERR3:
MOV      AX,0
JMP      SHORT EMS_19_EXIT
;attribute type not defined.

EMS_19:
JMP      SHORT EMS_19_EXIT
ENDP

;=====
;Function 20: Get/Set Handle Name
;=====
PROC      NEAR
ASSUME   CS:CODE,DS:CODE,ES:NOTHING
PUSH     SI
PUSH     DI
PUSH     DS
JMP      EMS_20_EXIT
;carry set, invalid handle
;find spot for handle
;get code segment
;compute offset by multiplying
; the handle number by the
; size of each entry (5).
MOV      AX,5
MUL      DX,AX
ADD      DS,HANDLE_ARRAY
;point dx past the handle used
; flag.
POP      AX
OR       AL,AL
JNE      EMS_20_01
;check for get or set subfn.

;get handle name
MOV      SI,DX
JMP      SHORT EMS_20_MOV

;set handle name
EMS_20_01:
CMP      AL,1
JNE      EMS_20_ERR1
;Make sure that subfunction
; = 1.
MOV      DS,SI*5+BP-8
;get original DS
ASSUME   DS:NOTHING
PUSH     SI
PUSH     DI
CALL     EMS_21_1
;first, search for handle
; with this name. The
; return code must be sh.
; or sh.
AND      AX,0FFH
CMP      AX,0
JNE      EMS_20_ERR2
;get hack oame pointer
PUSH     CS
PUSH     ES
ASSUME   ES:CODE
MOV      CX,8
;copy name. move 8 bytes
REP      MOVSB
;clear return code
MOV      DS,SI
POP      DI
POP      SI
JMP      EMS_20_ERR1
;invalid subfunction

EMS_20_ERR1:
JMP      SHORT EMS_20_EXIT
;Handle already used

EMS_20_ERR2:
JMP      SHORT EMS_20_EXIT
ENDP

;=====
;Function 21: Get Handle Directory
;=====
PROC      NEAR
ASSUME   DS:NOTHING,ES:NOTHING
DSI      OFFSETH EMS_21_0 ;Jump table for subfunctions
DSI      OFFSETH EMS_21_1
DSI      OFFSETH EMS_21_2
PROC      NEAR
ASSUME   CS:CODE,DS:CODE,ES:NOTHING
PUSH     DS
PUSH     DI
PUSH     SI
;get original DS
MOV      DS,SI*5+BP-8
;check subfunction < 3
JAE      EMS_21_ERROR
;clear top byte of subfunction
MOV      DI,AX
;convert loto byte address
SAL      DI,1
AND      DI,OFFSETH EMS_21_TAL
CALL     CS:[DI]
POP      DI
RET

EMS_21_ERROR:
MOV      AX,0FFH
JMP      SHORT EMS_21_EXIT
;invalid subfunction

EMS_21:
JMP      SHORT EMS_21_EXIT
ENDP

;Function 21.0: Get Handle Directory
;=====
PROC      NEAR
ASSUME   DS:NOTHING,ES:NOTHING
PUSH     DS
PUSH     DI
PUSH     SI
;get original DS
MOV      DS,SI*5+BP-4
;get original DI
;clear RC and hndi counter
;start with handle #
MOV      AX,AX

```



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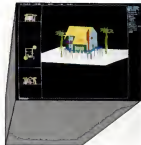
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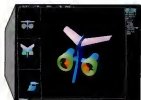
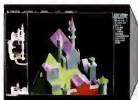
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Diamond Scan 20L* (HL8905TK)	20/19V	30 ~ 54 auto-tracking	0.31				*	*	*	*	*
XC1429C	14/13V	31 5	0.28			*					
XC1410C	14/13V	22 or 15.75	0.40	*	*						
XC1430C	14/13V	22 or 15.75	0.31	*	*						

*Microprocessor-enhanced programmable display settings



And Value.

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CIRCLE 499 ON READER SERVICE CARD

Utilities

EMS40.ASM

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```
POP     BX                ;Get back seg start of window
AND     BX,1B400          ;Add 46 Kbytes.
XCH     BX,SI             ;start at offset 0
PUSH    SI
CALL    LOAD_HEADER       ;Load memory requirements into
POP     SI                ; request header.
MOV     DI,OFFSET PROGRAM ;Print copyright
MOV     SI,0
JMP     $
```

```

Vector interrupt 15h to reserve the extended memory.

```

```

PUSH    R0
MOV     R0,1515H           ;set interrupt vector 15
INT     51H
MOV     OLD_INT15R0,R0
MOV     OLD_INT15R0,R0
POP     R0
MOV     R0,1515H           ;set interrupt vector 15
MOV     DS_OFFSET_INT_15H
CALL    DS_OFFSET_INT_15H

```

```

;vector the 47k interrupt to the driver. Jump to final installation code

```

```
MOV    AX, $5472          ;Set interrupt vector #7
MOV    BX, OFFSET INT_47H
INT     $10                ;Call BIOS
JMP     $FFFF              ;jump to final init. code.
```

```

=====
server routine to abort instalation.

```

```

SYSR_00000000      MOV     EDI,OFFSET DRIVER_CODE      ;tell user that the driver is
MOV     EDI,0      ;not loaded.
INT     21h
MOV     EDI,00000000      ;Get DOS version
INT     21h
RCMD0      AL,AL      ;Put number in proper order
CMP     EDI,00000000      ;see if DOS 3.1
MOV     EDI,OFFSET DRIVER_CODE      ;offset of driver code
JBE     RCX,CX      ;if 00.3, short install with
JMP     SYSR_00000000      ;memory. Otherwise leave
JNB     SYSR_00000000      ;delay with install

```

```

ERROR_ABORT_HANDLER:
    CALL    LOAD_HEADER          ;Load into request header
    MOV     EB,EBX              ;Indicate error in the
    RET                     ; driver return code.
;=====
;===== Load the rest of error loaded into the request header.

```

```

LOAD_HEADER      PROC      EXTR
LDS              DS:[REQ_HEADER]          ;get addr of req hdr
MOV              WORD PTR DS:[DI.Address],00 ;store offset and
MOV              WORD PTR DS:[DI.Address+3],00 ; code segment.
RET

```

```

LOAD HEADER          STOP
=====
; ScanFor = scans for first (non)occurrence of character in line.
; Strty - 00 - 0 = scan for non character, 1 = scan for character
; DStr1 - string to scan.  CH - length of string
; Exit - AS - 1 = end of line found.

```

```
SCAM_FOR      PROC      NEAR
                EOR      EB,EB                ;clear found flag
SCAM_LOOP1:    LODSB
                OR       EB,EB                ;see if first match or
                JE       SCAM_SKIP1          ; mismatch, 0 = match
                CWD      ECX                  ;check for nonchance
```

```

                                AL,255                                ;check for character
SCAM_SHIP1:  CMP
                                JLE SCAM_SHIP4
                                JMP SHORT SCAM_SHIP3

```

```

SCAN_SKIP:  JR      SCAN_SKIP
             CMP     AL,17             ;Check for CR
             JR      SCAN_SKIP
             CMP     AL,18             ;Check for LF
             JR      SCAN_SKIP
             LOOP    SCAN_LOOP1
SCAN_EXIT:   INC     CX               ;character not found
             RET

```

SCAM '812221	ENC	00	PERIODIC INFO. MISC. ADDRESS
SCAM '812241	REV		
SCAM 'FOR	ENDD		
END 05 CORR	=	1	
INVTAL 100	ENDD		
0000	ENDD		

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EMS40.BAS

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```

100 END - BASIC PROGRAM TO CREATE END48REV.COM
110 CUS=PRINT "creating END48REV.COM": OPEN "END48REV.COM" AS #1 LEN = 1
120 FIELD #1, 1 AS A$: CHECKSUM=#
130 FOR J = 3 TO 510
140 LINE$=0: LOCATE 5,5: PRINT "Countdown: " 510 - J ;
150 FOR I = 1 TO 16: READ ST$: ST$ = VAL("65" + ST$)
160 CHECKSUM = CHECKSUM + ST$: LINE$=LINE$ + ST$

```

```

170 IF (STRE < 336) THEN LEVY AL=CHG$(STRE): PUT $I
180 NEXT J
190 READ LIMSTOTS: LINCCHCK$ = VAL("a"*(LIMSTOTS))
200 IF LINCCHCK$ = LINESUM THEN GOTO 336
210 GOSUB 4,2: PRINT "Error in line # " & STY & " + 15 + I: goto 200

```

```

330 NEXT J
330 CLOSE: READ FILETOT: FILECHECK = VAL(FILETOT)
340 IF CHECKING <> FILECHECK THEN GOTO 340
350 PRINT: PRINT "*****.COM created successfully": SYSTEM
360 WAIT: WAIT "*****.COM is now valid...".

```

[illegible][illegible][illegible][illegible]

458 DATA	1,	90,	1	89,	1	81,	1	8,	5,	A,	2	43,	5,	5,	A,	51,	51
459 DATA	A,	47,	5	79,	5	94,	5	CT,	5	6A,	5	A3,	3	88,	3	C,	42
478 DATA	4,	33,	4	84,	4	13,	5	19,	5	86,	5	44,	8	95,	8	CC,	38
488 DATA	8,	19,	9	53,	A	5A,	9	56,	8A	TC,	TA,	FC,	51,	57,	54,	18,	57
498 DATA	4,	8	1P	88,	PC	5P	75	58,	8A	TC	88	7C	54	88	54,	1	

000 DATA 57,	58,	59,	60,	61,	62,	63,	64,	65,	66,	67,	68,	69,	70,	71,	72,	73,	74,	75,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88,	89,	90,	91,	92,	93,	94,	95,	96,	97,	98,	99,
010 DATA 58,	59,	60,	61,	62,	63,	64,	65,	66,	67,	68,	69,	70,	71,	72,	73,	74,	75,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88,	89,	90,	91,	92,	93,	94,	95,	96,	97,	98,	99,	
020 DATA 59,	60,	61,	62,	63,	64,	65,	66,	67,	68,	69,	70,	71,	72,	73,	74,	75,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88,	89,	90,	91,	92,	93,	94,	95,	96,	97,	98,	99,		
030 DATA 60,	61,	62,	63,	64,	65,	66,	67,	68,	69,	70,	71,	72,	73,	74,	75,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88,	89,	90,	91,	92,	93,	94,	95,	96,	97,	98,	99,			

948 DATA 4	88	1	7	C3	84	89	86	78	53	52	72	10	3C	3	7F	40
950 DATA 10	83	78	77	75	8	8A	24	32	C8	33	82	8B	7	84	88	87
960 DATA 75	8	58	72	3	28	43	5	33	C8	5A	58	C3	84	88	8B	73
970 DATA 77	53	52	72	12	83	77	28	DC	8	A	52	74	13	2	7	72
980 DATA 82	3E	4	3	88	C3	85	8	8	77	81	3	78	35	C8	73	7

[illegible]

428 DATA 5A, 99, 0.3, 82, 95, 75, 107, 86, 26, 4, 1, 95, 2, 8, 83, 28, 57
438 DATA 13, 39, 14, 75, 5, 83, 17, 84, 82, 88, 9, C7, 4, 8, 8, 28, 57
458 DATA 95, 8, 33, C9, 5A, 56, C3, 88, 32, 4, 1, 32, 88, 8, 8, 57
468 DATA 1, 5A, 38, 74, 5, 7A, C3, 83, C7, 8, 82, 78, 33, C9, C3, 57, 78
478 DATA 75, 14, 88, 28, 3, 1, 88, 5, 78, 8, 33, 78, 5A, 15, 75, 1, 48

600 DATA 42, 81, C7, 3, 85, PP, 22, C8, 57, C3, 55, 52, 12, 3, P8, 88, 88
608 DATA 50, 8, 88, 88, PP, 75, 8, 46, 56, 83, 15, 36, 85, 50, 5, 43, 78
700 DATA 82, C7, 4, 38, 15, 8, 1, 70, 86, 88, 88, 33, C9, 5A, C3, 88, 78
710 DATA 2, P8, 2, 15, 3, 28, 3, 53, 55, 18, 88, 58, PP, 3C, 3, 77, 45
720 DATA 11, 35, 88, 88, 88, 15, 83, 88, C3, 88, 8, 38, PP, 12, 18, 88

730 DATA	50,	C5,	64,	8F,	8B,	FF,	54,	1E,	8,	1F,	80,	3E,	6,	3,	8D,	9,	60
740 DATA	6,	F3,	A3,	25,	84,	1F,	50,	C3,	56,	33,	00,	85,	C6,	5,	00,	4,	70
750 DATA	86,	54,	5,	83,	83,	14,	6,	60,	83,	C6,	6,	43,	80,	70,	5,	7E,	61

140	DATA	00,	32,	04,	58,	C3,	67,	85,	CD,	FF,	5F,	09,	06,	FF,	35,	04,	C3,	05
170	DATA	08,	18,	8,	C3,	08,	1,	00,	1,	96,	3,	53,	03,	18,	00,	58,	F0,	05
180	DATA	26,	04,	3C,	2,	73,	F,	00,	FF,	01,	07,	01,	C7,	54,	3,	35,	FF,	70
190	DATA	15,	1F,	04,	50,	C3,	04,	0F,	00,	F0,	00,	70,	FC,	00,	C,	20,	03,	02
200	DATA	0,	20,	04,	5,	00,	00,	0,	70,	04,	30,	00,	3,	00,	07,	00,	00,	00

010 OREN	2	28	64	2	40	10	12	28	28	27	20	2	24	38	27	38
010 OREDA	23	28	3	12	6	1	28	88	67	5	56	89	48	4	28	88
020 DAVA	47	4	28	89	43	6	63	67	6	44	46	23	24	33	68	63
030 DAVA	88	6	88	50	5	88	44	4	88	34	4	28	89	7	63	68
040 OREDA	6	83	83	33	68	63	88	63	84	4	74	24	3	4	33	74

950 DATA	84,	C3,	88,	46,	F8,	88,	1,	8,	C3,	93,	95,	78,	28,	3C,	1,	77,	75
960 DATA	2F,	C3,	FF,	4,	77,	28,	5A,	88,	56,	88,	46,	5,	A,	88,	74,	7,	87
970 DATA	8F,	61,	4,	73,	16,	5A,	C3,	56,	88,	1C,	FF,	81,	88,	8A,	F8,	89,	87
980 DATA	A,	8A,	75,	9,	82,	C6,	4,	F8,	C8,	75,	00,	33,	C8,	5A,	88,	C3,	87
990 DATA	84,	8F,	88,	FF,	84,	00,	88,	F8,	62,	85,	73,	11,	88,	F8,	53,	88,	87

[illegible]

978 DATA 06	08	03	03	00	18	14	04	20	0C	08	00	03	00	07	00
979 DATA 04	00	04	5	16	4	1	43	00	4	00	75	4	00	F2	00
980 DATA 1A	3C	1	75	51	00	50	FF	04	03	03	71	0	5A	3E	00
979 DATA 04	FE	00	FC	AF	75	13	00	FA	5	7	00	0	0	F3	AD
980 DATA 33	C8	1F	5A	50	C3	04	0F	00	FE	04	A2	00	FE	0F	4

1998 DATA CH.	4.	0.	5.	10.	5A.	00.	FF.	3C.	5.	77.	F.	15.	04.	00.	FF.	40.
1998 DATA H1.	07.	01.	07.	78.	4.	70.	FF.	10.	1F.	C4.	0F.	00.	7A.	02.	00.	00.
1910 DATA H.	1F.	03.	36.	4.	1.	00.	78.	FC.	33.	C9.	00.	00.	3C.	0.	0.	0.
1820 DATA W.	10.	50.	00.	10.	40.	03.	07.	5.	00.	0.	73.	0A.	7A.	C0.	0.	0.
1830 DATA W.	5.	03.	00.	0.	40.	70.	10.	0.	1.	70.	00.	5A.	C3.	10.	0.	0.

[illegible]

1596	DATA	33	CF	75	53	60	FR	80	70	14	80	20	40	74	3
1598	DATA	34	FR	75	2	89	74	4	34	89	20	0	34	89	7
1599	DATA	34	FR	75	2	89	74	4	34	89	20	0	34	89	7
1600	DATA	34	CF	40	4	35	80	60	71	FR	C3	75	9	30	5
1601	DATA	34	CF	40	4	35	80	60	71	FR	C3	75	9	30	5
1602	DATA	34	CF	40	4	35	80	60	71	FR	C3	75	9	30	5
1603	DATA	34	CF	40	4	35	80	60	71	FR	C3	75	9	30	5
1604	DATA	34	CF	40	4	35	80	60	71	FR	C3	75	9	30	5
1605	DATA	34	CF	40	4	35	80	60	71	FR	C3	75	9	30	5
1606	DATA	34	CF	40	4	35	80	60	71	FR	C3	75	9	30	5
1607	DATA	34	CF	40	4	35	80	60	71	FR	C3	75	9	30	5
1608	DATA	34	CF	40	4	35	80	60	71	FR	C3	75	9	30	5
1609	DATA	34	CF	40	4	35	80	60	71	FR	C3	75	9	30	5
1610	DATA	34	CF	40	4	35	80	60	71	FR	C3	75	9	30	5
1611	DATA	34	CF	40	4	35	80	60	71	FR	C3	75	9	30	5
1612	DATA	34	CF	40	4	35	80	60	71	FR	C3	75	9	30	5
1613	DATA	34	CF	40	4	35	80	60	71	FR	C3	75	9	30	5
1614	DATA	34	CF	40	4	35	80	60	71	FR	C3	75	9	30	5
1615	DATA	34	CF	40	4	35	80	60	71	FR	C3	75	9	30	5
1616	DATA	34	CF	40	4	35	80	60	71	FR	C3	75	9	30	5
1617	DATA	34	CF	40	4	35	80	60	71	FR	C3	75	9	30	5
1618	DATA	34	CF	40	4	35	80	60	71	FR	C3	75	9	30	5
1619	DATA	34	CF	40	4	35	80	60	71	FR	C3	75	9	30	5
1620	DATA	34	CF	40	4	35	80	60	71	FR	C3	75	9	30	5
1621	DATA	34	CF	40	4	35	80	60	71	FR	C3	75	9	30	5
1622	DATA	34	CF	40	4	35	80	60	71	FR	C3	75	9	30	5
1623	DATA	34	CF	40	4	35	80	60	71	FR	C3	75	9	30	5
1624	DATA	34	CF	40	4	35	80	60	71	FR	C3	75	9	30	5
1625	DATA	34	CF	40	4	35	80	60	71	FR	C3	75	9	30	5
1626	DATA	34	CF	40	4	35	80	60	71	FR	C3	75	9	30	5
1627	DATA	34	CF	40	4	35	80	60	71	FR	C3	75	9	30	5
1628	DATA	34	CF	40	4										

1130 DATA 47,	PI,	A,	04,	08,	70,	50,	00,	40,	4,	00,	00,	00,	44,	FF,	00,
1140 DATA 00,	PI,	00,	76,	70,	00,	70,	PC,	00,	70,	70,	00,	00,	40,	0,	00,
1150 DATA 0,	0,	FF,	10,	00,	50,	00,	00,	00,	00,	00,	40,	00,	00,	50,	00,
1160 DATA 00,	75,	PA,	00,	70,	PC,	00,	40,	PI,	50,	00,	40,	4,	00,	40,	0,
1170 DATA 0,	PI,	00,	70,	70,	00,	00,	00,	00,	00,	00,	40,	00,	00,	00,	00,

1179	DATA	41	17	27	7	30	40	29	06	40	7	39	00	70	3	20	00	00
1180	DATA	41	C	78	58	28	72	PC	C3	53	58	44	79	5	36	55		
1194	DATA	00	0C	03	0C	19	08	46	77	C4	46	71	0	39	00	4	24	
1200	DATA	00	54	2	03	7A	10	75	9	04	04	00	70	1	05	44	7A	
1219	DATA	00	04	PC	09	0	48	77	F1	5A	09	8A	0A	03	C4	4	07	

[illegible]

1570	DATA	88,	7,	68,	44,	78,	1,	54,	38,	7c,	5,	75,	64,	77,	23,	26,	38,
1580	DATA	5C,	3,	75,	3C,	58,	26,	38,	67,	72,	19,	77,	4,	38,	C3,	73,	13,
1590	DATA	60,	72,	77,	68,	78,	8,	87,	78,	53,	88,	79,	77,	64,	87,	6,	C8,
1600	DATA	46,	77,	1,	29,	58,	78,	16,	78,	7C,	38,	87,	75,	13,	38,	C3,	79,

1215	DATA	FC	C5	05	21	52	86	18	37	8	14	3	88	97	88	9	1
1230	DATA	00	18	5	1	37	77	8	37	77	6	37	77	4	37	77	2
1235	DATA	FC	00	10	28	0	79	12	3C	26	00	44	3C	26	00	94	70
1240	DATA	00	44	70	07	04	70	26	00	44	3	34	00	04	0	05	04

EMS40.BAS: If you don't have a macro assembler, you can create the EMS40.SYS device driver simply by running this program in BASIC

EMS40 BY MODEM

The programs published in *PC Magazine* are available by modem from PC MagNet, an on-line information service.

To download EMS40.SYS, log on to PC MagNet. Enter GO UTILITIES or choose PC MAGAZINE UTILITIES from the top menu, then DIRECT UTILITY DOWNLOAD from the next. Enter the filename, then select the appropriate file from those presented. Answer (Y) to DO YOU WISH TO DOWNLOAD? Press Enter to see the transfer protocols. Choose a protocol and download the file.

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EMS40.SYS Device Driver

Douglas Boling

June 27, 1989 (Utilities)

Purpose:

Emulates the Lotus/Intel/Microsoft Expanded Memory Specification, Version 4.0, in software, permitting extended memory in AT-class machines to be used as expanded memory.

Format:

DEVICE=[d:] [path] EMS40.SYS [nnn]

Remarks:

EMS40.SYS is installed by being listed in the CONFIG.SYS file. The drive and path information must be supplied if they are needed by DOS to find the driver at boot-up. Once installed, EMS40.SYS cannot be removed from memory without rebooting.

The optional *nnn* parameter allows the user to specify the amount of extended memory, in kilobytes, that will be used as expanded memory by EMS40.SYS. If the amount is omitted, the default value is 384K. By setting *nnn* to a smaller value than that of the extended memory installed, space can be reserved for extended-memory programs such as VDISK.

EMS40.SYS maps extended memory into four contiguous 16K pages in conventional DOS memory, permitting access to large spreadsheets and other data that would otherwise result in a "Memory Full" error. While not as fast as a dedicated LIM/EMS board and driver, EMS40.SYS implements, within the limitations of a software emulation, all 28 functions specified in LIM/EMS 4.0. (It does not attempt, however, to emulate the DMA functions included in function 28, Alternate Map Register Set.)

Available for downloading from PC MagNet (see the "EMS40 by Modem" sidebar), EMS40.SYS is already compiled and ready to run. As an alternative, EMS40.SYS can be created from either of two program files that are printed in the article and are also available for downloading from PC MagNet. EMS40.BAS will automatically create EMS40.SYS when run once in BASIC. To create EMS40.SYS from the EMS40.ASM source code requires the use of a macro assembler (IBM or Microsoft, Version 2.0 or later) and the following commands:

```
MASM EMS40;
LINK EMS40;
EXE2BIN EMS40 EMS40.SYS;
```

BULLDOG STANDS OUT AMONG THE COMPETITION

PRINTERS		DRIVES		SOFTWARE	
EPSON		Seagate 20 mb w/contr.ST225	\$259	Aldus Pagemaker 3.0	\$465
LX 810 NEW?	\$195	Seagate 30 mb w/contr.ST238	279	Chartmaster	205
FX 850 254 CPS, 54 NLQ	339	Seagate 40 mb for AT ST251-1	409	Clipper	419
FX 1050 364 CPS, 54 NLQ	429	Seagate 40 mb for AT ST251	349	D Base IV	469
LQ 510 NEW?	329	Seagate 80 mb ST4096	575	DBXL	125
LQ 850 330 CPS, 88 NLQ	519	CMS 5-1/4" ext. 360K for PS/2	179	Enable O/A	349
LQ 950 330 CPS, 88 NLQ	549	CMS 5-1/4" ext. 12 mb for PS/2	199	Fastback Plus	105
LQ 1050 330 CPS, 88 NLQ	719	Pacific Rim 5-1/4" ext. 360K for PS/2	179	Foxtbase +	189
LQ 2550 600 CPS, 108 NLQ	899	Pacific Rim 5-1/4" ext. 1.2 for PS/2	199	Freelance Plus	329
OKIDATA		Toshiba 3-1/2" 720K int.	89	Framework III	439
182 Plus 180 CPS, 30 NLQ	229	Toshiba 3-1/2" 1.44 mb int.	105	Harvard Graphics	275
320/321 300 CPS, 62 NLQ	339/465	Toshiba 5-1/4" 360K int.	68	IBM Display Write IV	269
390/24 PIN 270 CPS, 90 NLQ	465	Toshiba 5-1/4" 1.2 mb int.	99	Lotus	299
391 24 PIN 270 CPS, 90 NLQ	639	Bernoulli Box II 5-1/4" 20 mb int.	955	Microsoft Word 4.0	209
292 240 CPS, 100 NLQ	439	20 mb ext. w/card	1199	Microsoft Excel	239
293 Plus 240 CPS, 100 NLQ	575	dual 20 mb external w/card	1769	Multimate Advantage II	269
393 450 CPS, 120 NLQ	995	Plus Hard Card 40	649	Peachtree II Complete	149
TOSHIBA		Plus Hard Card 20	525	PFS Prof Write	119
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351 SX 350 CPS, 100 NLQ	950	Priam 43 mb AT	449	Paradox 3.0	449
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1949	DATA	P	83	52	4	22	PC	87	45	6	57	88	55	2	50	C	71	718	1849	DATA	P	83	52	4	22	PC	87	45	6	57	88	55	2	50	C	71	718
1950	DATA	P	83	52	4	22	PC	87	45	6	57	88	55	2	50	C	71	719	1850	DATA	P	83	52	4	22	PC	87	45	6	57	88	55	2	50	C	71	719
1951	DATA	P	83	52	4	22	PC	87	45	6	57	88	55	2	50	C	71	720	1851	DATA	P	83	52	4	22	PC	87	45	6	57	88	55	2	50	C	71	720
1952	DATA	P	83	52	4	22	PC	87	45	6	57	88	55	2	50	C	71	721	1852	DATA	P	83	52	4	22	PC	87	45	6	57	88	55	2	50	C	71	721
1953	DATA	P	83	52	4	22	PC	87	45	6	57	88	55	2	50	C	71	722	1853	DATA	P	83	52	4	22	PC	87	45	6	57	88	55	2	50	C	71	722
1954	DATA	P	83	52	4	22	PC	87	45	6	57	88	55	2	50	C	71	723	1854	DATA	P	83	52	4	22	PC	87	45	6	57	88	55	2	50	C	71	723
1955	DATA	P	83	52	4	22	PC	87	45	6	57	88	55	2	50	C	71	724	1855	DATA	P	83	52	4	22	PC	87	45	6	57	88	55	2	50	C	71	724
1956	DATA	P	83	52	4	22	PC	87	45	6	57	88	55	2	50	C	71	725	1856	DATA	P	83	52	4	22	PC	87	45	6	57	88	55	2	50	C	71	725
1957	DATA	P	83	52	4	22	PC	87	45	6	57	88	55	2	50	C	71	726	1857	DATA	P	83	52	4	22	PC	87	45	6	57	88	55	2	50	C	71	726
1958	DATA	P	83	52	4	22	PC	87	45	6	57	88	55	2	50	C	71	727	1858	DATA	P	83	52	4	22	PC	87	45	6	57	88	55	2	50	C	71	727
1959	DATA	P	83	52	4	22	PC	87	45	6	57	88	55	2	50	C	71	728	1859	DATA	P	83	52	4	22	PC	87	45	6	57	88	55	2	50	C	71	728
1960	DATA	P	83	52	4	22	PC	87	45	6	57	88	55	2	50	C	71	729	1860	DATA	P	83	52	4	22	PC	87	45	6	57	88	55	2	50	C	71	729
1961	DATA	P	83	52	4	22	PC	87	45	6	57	88	55	2	50	C	71	730	1861	DATA	P	83	52	4	22	PC	87	45	6	57	88	55	2	50	C	71	730
1962	DATA	P	83	52	4	22	PC	87	45	6	57	88	55	2	50	C	71	731	1862	DATA	P	83	52	4	22	PC	87	45	6	57	88	55	2	50	C	71	731
1963	DATA	P	83	52	4	22	PC	87	45	6	57	88	55	2	50	C	71	732	1863	DATA	P	83	52	4	22	PC	87	45	6	5							

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2399	DATA	3	CI	A3	6	1	8	8	8	8	8	8	8	8	8	8	8	2400	DATA	2	CP	21	BP	50	FP	NA	3	C	NA	3	21	BP	50	668
2400	DATA	FP	NA	3	CI	A3	6	1	8	8	8	8	8	8	8	8	8	2401	DATA	3	CP	21	BP	50	FP	NA	3	C	NA	3	21	BP	50	669
2401	DATA	FP	NA	3	CI	A3	6	1	8	8	8	8	8	8	8	8	8	2402	DATA	4	CP	21	BP	50	FP	NA	3	C	NA	3	21	BP	50	670
2402	DATA	FP	NA	3	CI	A3	6	1	8	8	8	8	8	8	8	8	8	2403	DATA	5	CP	21	BP	50	FP	NA	3	C	NA	3	21	BP	50	671
2403	DATA	FP	NA	3	CI	A3	6	1	8	8	8	8	8	8	8	8	8	2404	DATA	6	CP	21	BP	50	FP	NA	3	C	NA	3	21	BP	50	672
2404	DATA	FP	NA	3	CI	A3	6	1	8	8	8	8	8	8	8	8	8	2405	DATA	7	CP	21	BP	50	FP	NA	3	C	NA	3	21	BP	50	673
2405	DATA	FP	NA	3	CI	A3	6	1	8	8	8	8	8	8	8	8	8	2406	DATA	8	CP	21	BP	50	FP	NA	3	C	NA	3	21	BP	50	674
2406	DATA	FP	NA	3	CI	A3	6	1	8	8	8	8	8	8	8	8	8	2407	DATA	9	CP	21	BP	50	FP	NA	3	C	NA	3	21	BP	50	675
2407	DATA	FP	NA	3	CI	A3	6	1	8	8	8	8	8	8	8	8	8	2408	DATA	10	CP	21	BP	50	FP	NA	3	C	NA	3	21	BP	50	676
2408	DATA	FP	NA	3	CI	A3	6	1	8	8	8	8	8	8	8	8	8	2409	DATA	11	CP	21	BP	50	FP	NA	3	C	NA	3	21	BP	50	677
2409	DATA	FP	NA	3	CI	A3	6	1	8	8	8	8	8	8	8	8	8	2410	DATA	12	CP	21	BP	50	FP	NA	3	C	NA	3	21	BP	50	678
2410	DATA	FP	NA	3	CI	A3	6	1	8	8	8	8	8	8	8	8	8	2411	DATA	13	CP	21	BP	50	FP	NA	3	C	NA	3	21	BP	50	679
2411	DATA	FP	NA	3	CI	A3	6	1	8	8	8	8	8	8	8	8	8	2412	DATA	14	CP	21	BP	50	FP	NA	3	C	NA	3	21	BP	50	680
2412	DATA	FP	NA	3	CI	A3	6	1	8	8	8	8	8	8	8	8	8	2413	DATA	15	CP	21	BP	50	FP	NA	3	C	NA	3	21	BP	50	681
2413	DATA	FP	NA	3	CI	A3	6	1	8	8	8	8	8	8	8	8	8	2414	DATA	16	CP	21	BP	50	FP	NA	3	C	NA	3	21	BP	50	682
2414	DATA	FP	NA	3	CI	A3	6	1	8	8	8	8	8	8	8	8	8	2415	DATA	17	CP	21	BP	50	FP	NA	3	C	NA	3	21	BP	50	683
2415	DATA	FP	NA	3	CI	A3	6	1	8	8	8	8	8	8	8	8	8	2416	DATA	18	CP	21	BP	50	FP	NA	3	C	NA	3	21	BP	50	684

bytes specify the segment starting address. Since the 80286 can address up to 16MB of memory, 24 bits are necessary to position the segment anywhere in the address space. The access byte is used in protected mode to indicate how the segment is to be used and what programs have access to it. Although this byte provides a variety of access methods, for the purposes of the Move Block function the access byte is loaded with 93h, which allows BIOS unlimited read/write access to the segment.

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Douglas Boling is an electrical engineer who has been involved in the design of computer hardware and software for 11 years.

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by
Charles Petzold

Environments

It shouldn't surprise you to learn that games are often the first programs written for a new graphical user interface. Games are often heavily interactive (which is what it's all about today); they tend to be graphics-intensive and require fast feedback to the user. Creating games is an excellent way for programmers to sharpen their GUI programming skills and gain experience with the keyboard, mouse, and graphics.

The OS/2 Presentation Manager is, of course, particularly well suited to highly interactive programs, programs that have menus, make use of graphics, and can benefit from mouse input. For the INISHOW program I discussed in the last issue, the PM would have been overkill. But this time around we are bringing a *game* to the staid pages of the Productivity section of *PC Magazine* and the PM is the perfect vehicle for its development and design.

JEU DE TAQUIN

Well, actually what I will be presenting is really a puzzle. The puzzle we'll be adapting to the OS/2 Presentation Manager was invented in the 1870s, probably by the famous puzzle-maker Sam Loyd. For a while it was all the rage, particularly in Europe, and was known under various names including the 15-Puzzle, the 14-15 Puzzle, the Boss Puzzle, and (in France) *Jeu de Taquin*.

In its classic form, the puzzle consists of 15 square blocks, numbered 1 through 15. The squares are arranged in a 4 by 4 grid, leaving one blank space. You can move the squares around the grid by shifting a square into the blank space, which in turn leaves open a different blank space.

As Sam Loyd presented it, the puzzle squares were arranged in consecutive order, except with the 14 and 15 reversed. He offered \$1,000 to anyone who could find a way to shift the squares around to correct the position of the 14 and 15. No one collected the reward because, from that starting point, the puzzle is insoluble.

A mathematical analysis of the 14-15 Puzzle appeared in an 1879 article in the

Creating a game is an
excellent way to gain
experience writing
interactive programs
using OS/2's GUI.

American Journal of Mathematics. If you're interested, the underlying math is summarized in Volume 4 of *The World of Mathematics*, by James R. Newman (1956, republished 1988 by Tempus Books, an imprint of Microsoft Press).

A Macintosh version, imaginatively called PUZZLE, is a common sight on Macs. A version for *Microsoft Windows*, called MUZZLE, is included in the Windows Software Development Kit. Both these programs initially display the 15 squares in consecutive (solved) order and present a menu option to scramble the squares. Using the mouse, you can attempt to restore the order of the squares or put the

squares into different arrangements, such as consecutive order going down the columns rather than across the rows.

THE PM VERSION

In this and my next column I'll show you how to write a Presentation Manager version of this famous puzzle. To distinguish it from both the Mac and *Windows* versions, I've called it TAQUIN. The screen photo in Figure 1 shows TAQUIN running in the Presentation Manager session of OS/2 1.1. A second copy of TAQUIN is also running in the PM session, but the copy has been "minimized," so it appears as a small icon (the fourth from the left) at the bottom of the screen.

The 15 squares are colored with two shades of gray, giving them a pseudo-3-D appearance. (Gray shading seems to be the rage in graphical user interfaces these days.) You can move the squares using either the keyboard or the mouse. With the keyboard, the cursor arrow keys move a square into the empty position. For example, in the arrangement shown in Figure 1, the down arrow key will move square 12 down, after which pressing the right arrow key will shift the 11 square to the right.

As is typical, however, the mouse interface is slightly more functional. It better emulates the way you might actually use



Figure 1: The TAQUIN puzzle running under the OS/2 Presentation Manager. A second copy of the program has been minimized to show on-screen as an icon.

Environments

your fingers, by letting you move more than a single square at a time. For example, in the initial arrangement shown in Figure 1, if you click on the 14 square, both the 14 and 15 squares move to the right. If you then click on the 2 square, the 2, 6, and 10 squares all move down. Any invalid keystrokes or mouse clicks are simply ignored.

TAQUIN has a menu with the single item "Options." If you click on the word (or press Alt-O), the submenu shown in the left half of Figure 2 is displayed. The Normal Reset option restores the squares to consecutive order. The Inverted Reset option restores the squares, but reverses the 14 and 15, as in Lloyd's presentation. The Scramble option randomly moves the squares around in software and then updates the screen.

The ellipsis (. . .) following the About Jeu de Taquin option indicates that this option will invoke a dialog box. In the copy of TAQUIN that is displayed on the right side of Figure 2, this has been done. The dialog box displays the program's icon, a copyright notice, and the name of the programmer.

THE TAQUIN FILES

Thus TAQUIN contains many of the common elements of a PM program, such as an icon, a menu, and a dialog box. The program displays graphics and processes both keyboard and mouse input. That gives us an opportunity to examine the steps involved in making a relatively complete—yet not very complex—full-scale

Presentation Manager program.

Like most Presentation Manager programs, TAQUIN is written in C, but the C source code file is not the only file needed to create the TAQUIN.EXE executable. A PM program is often built from several files. In the case of TAQUIN, six files are needed, as shown in Figure 3.

In this column I'll discuss the first five files on the list. The last and most important, TAQUIN.C, will be explored in depth next time. (To anticipate a little, by changing two identifiers in TAQUIN.C you'll be able to go beyond the 4 by 4 version and recompile it for various dimensions—5 by 5, 6 by 6, or 3 by 8, or most anything else.) Of course, you can download all these files (as well as TAQUIN.EXE) from PC MagNet.

But why so many files to create one program? In this column, let's find out by examining each of them.

THE MAKE FILE

The Make file, which is usually given the same filename—but without any extension—such as the program itself, helps you more easily construct the .EXE file from its various components. The TAQUIN Make file is shown in Figure 4. Assuming that you have installed the IBM or Microsoft C compiler and OS/2 1.1 Programmer's Toolkit, you can create TAQUIN.EXE simply by entering

MAKE TAQUIN

In the Make file, the lines that are not indented list a target file to the left of the colon and the dependent files to the right of the colon. If the file date and time of any of the dependent files is later than the target

file (or if the target file does not exist), then the indented command or commands that follow are executed.

The TAQUIN Make file invokes the C compiler, CL.EXE; the resource compiler, RC.EXE (described below); and the linker, LINK.EXE. Note that the other five files listed in Figure 3 all appear as dependent files in the TAQUIN Make file.

THE RESOURCE SCRIPT

The TAQUIN.RC resource script is shown in Figure 5. If you've never done any programming for a graphical user interface, the concept of "resources" is probably new to you. Resources are read-only data

The Files Needed to Create TAQUIN.EXE	
Filename	Description
TAQUIN	Make file
TAQUIN.RC	Resource script
TAQUIN.ICO	Binary icon file
TAQUIN.H	Header file
TAQUIN.DEF	Module definition file
TAQUIN.C	C source code file

Figure 3: The six files listed above are required to create the TAQUIN.EXE executable file.

that are stored, along with the normal code and data segments that make up the program, in the program's .EXE file.

TAQUIN has three resources: an icon, a menu template, and a dialog box template. The resource script either contains the program's resources, in ASCII form (as in the case of the menu and dialog box template), or it refers to other files that contain a resource (in this case, the binary TAQUIN.ICO file that holds the program's icon).

The resource compiler, RC.EXE, has two jobs. First, it compiles the resources into a binary form and stores them in the RC.RES file. Second, it adds the compiled resources to the RC.EXE file after the file is linked. The program can then reference these resources when it runs.

The menu template is organized in a hierarchical structure that parallels the resultant menu. The MENU, SUBMENU, and MENUITEM statements in the menu template are keywords recognized by the resource compiler. ID_RESOURCE and the four identifiers beginning with IDM ("ID for a Menu") are constants that are defined in the TAQUIN.H header file. The TA-

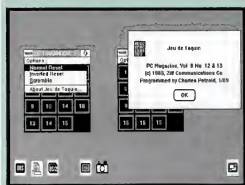


Figure 2: In this screen shot, two copies of TAQUIN are shown running simultaneously under the OS/2 Presentation Manager. On the left the program's submenu is displayed; the dialog box is shown on the right.

Environments

QUIN.C program uses ID_RESOURCE to refer to both the icon and the menu template. The menu window that the program creates based on this menu template uses the four IDM constants to signal the program when a user selects a menu item.

The dialog box template is a bit more complex than the menu template. The template defines a hierarchical structure of

windows that appear within the dialog box. In this case, most of these windows simply contain centered text strings (indicated by the keyword CTEXT).

The various numbers shown in the dialog box template refer to the position and size of the windows within the dialog box. These numbers designate special device-independent coordinates and sizes that are used only in dialog box templates. Thus, the horizontal coordinates and sizes shown are multiples of 1/4 the average width of a system font character. Vertical coordinates

TAQUIN MAKE FILE

COMPLETE LISTING

```
#-----#
# TAQUIN make file
#-----#

taquin.obj : taquin.c taquin.h
cl -c -G2sw -W3 taquin.c

taquin.res : taquin.rc taquin.h taquin.ico
rc -r taquin

taquin.exe : taquin.obj taquin.def
link taquin, /align:16, NUL, os2, taquin
rc taquin.res

taquin.exe : taquin.res
rc taquin.res
```



Figure 4: The TAQUIN Make file assists in the creation of TAQUIN.EXE.

TAQUIN.RC

COMPLETE LISTING

```
/*-----*/
/* TAQUIN.RC resource script */
/*-----*/

#include <cs2.h>
#include "taquin.h"

POINTER ID_RESOURCE taquin.ico

MENU ID_RESOURCE
{
    SUBMENU "Options", -1
    {
        MENUITEM "Normal Reset", IDM_NORMAL
        MENUITEM "Inverted Reset", IDM_INVERT
        MENUITEM "Scramble", IDM_SCRAMBLE
        MENUITEM SEPARATOR
        MENUITEM "A bout Jeu de Taquin...", IDM_ABOUT
    }
}

DLGTEMPLATE IDD_ABOUT
{
    DIALOG "", 0, 32, 32, 288, 188,, FCF_OLGBORDER
    {
        CTEXT "Jeu de Taquin" -1, 18, 76, 188, 8
        ICON ID_RESOURCE -1, 8, 68, 8, 8
        CTEXT "PC Magazine, Vol. 8 No. 12 & 13", -1, 18, 52, 188, 8
        CTEXT "(c) 1989, Ziff Communications Co." -1, 18, 42, 188, 8
        CTEXT "Programmed by Charles Petsold, 1/89" -1, 18, 32, 188, 8
        OKEPUSHBUTTON "OK" OIO_OK, 88, 8, 48, 16, WS_GROUP
    }
}
```



Figure 5: The TAQUIN.RC resource script file either contains all of the program's resources, or it references other files that contain such resources.

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Environments

and sizes are in units of $\frac{1}{4}$ the height of a system font character. The reason for using these special scales is to ensure that the dialog box will look roughly the same, regardless of the resolution of the video adapter on which the program runs.

The TAQUIN.C program can refer to the dialog box template by using the identifier `IDD_ABOUT`, which is defined in `TAQUIN.H`.

THE ICON FILE

`TAQUIN.ICO` is the only non-ASCII file among the six files shown in Figure 3. Icons are usually stored in a binary bitmap form, with rows and columns of pixels. You create an icon file using the `ICON-EDIT` program included in the IBM or Microsoft OS/2 1.1 Programmer's Toolkit. Figure 6 shows the completed `TAQUIN.ICO` icon in `ICONEDIT`.

THE HEADER FILE

The `TAQUIN.H` header file, listed in Figure 7, defines constants that are used in

both the `TAQUIN.RC` resource script and the `TAQUIN.C` program we'll examine in the next issue.

To load the icon, menu template, and dialog box template, the `TAQUIN.C` program must be able to refer to each of them by an ID number. For the icon and menu template, this is provided by `ID_RESOURCE`, and for the dialog box template, by `IDD_ABOUT`.

In addition, when the user selects an

item from the menu, the menu window sends a message to the client window. The message identifies the selected item by the identifier in the menu template. The `TAQUIN.C` program uses the `IDM` identifiers defined in `TAQUIN.H` to determine which item the user has selected.

THE MODULE DEFINITION FILE

`TAQUIN.DEF`, which is shown in Figure 8, is the module definition file. It contains



Figure 6: Icons, which are stored in binary bitmap form, are created using the `ICONEDIT` program. This screen shot shows the completed `TAQUIN.ICO` icon in `ICONEDIT`.

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Environments

TAQUIN.H COMPLETE LISTING

```
/*
  TAQUIN.H header file
  */

#define ID_RESOURCE 1

#define IDM_NORMAL 1
#define IDM_INVERT 2
#define IDM_SCRAMBLE 3
#define IDM_ABOUT 4

#define IDD_ABOUT 1
```



Figure 7: TAQUIN.H defines identifiers used both in TAQUIN.C and in TAQUIN.RC.

TAQUIN.DEF COMPLETE LISTING

```
/*
  TAQUIN.DEF module definition file
  */

NAME TAQUIN WINDOWAPI

DESCRIPTION 'Jeu de Taquin (c) 1989, Ziff Communications Co.'

PROTOSIZE 1024
STACKSIZE 8192
EXPORTS ClientWndProc
          AboutDlgProc
```



Figure 8: TAQUIN.DEF contains information LINK uses in constructing TAQUIN.EXE.

all of the information that is necessary to enable LINK to construct the program's .EXE file.

The WINDOWAPI keyword identifies TAQUIN as a Presentation Manager program. In the May 16, 1989, Environments column, I discussed how LINK uses this keyword in order to set a flag in the .EXE file. This flag assists OS/2 in determining the program type when loading the program to run.

The ASCII string that follows the DESCRIPTION statement is embedded by LINK in the .EXE file. You can use this entry for whatever you want; version numbers and copyright notices are the most common uses.

Finally, the EXPORTS statement lists the two window procedures found in TAQUIN. These are ClientWndProc, the window procedure for the program's client window, and AboutDlgProc, the window procedure for the dialog box. As we'll see in the next issue, it is these two window procedures that make up the bulk of the TAQUIN.C program.

by
Ray Duncan

Power Programming

In the last two columns, I've discussed the concepts of conventional and extended memory, the ROM BIOS routines your own programs can call to access extended memory, and the primitive but widely used VDISK and interrupt 15h schemes for extended memory management. In 1988—some 4 years after the introduction of the first 80286-based computers that supported extended memory—two new, more-sophisticated approaches to extended memory management were introduced. In this issue we'll take a look at these competing newcomers, which are known by their cryptic acronyms: XMS and VCPI.

THE XMS

The eXtended Memory Specification (XMS) is the result of a collaborative effort by Lotus, Intel, Microsoft, and AST Research. It defines a software interface for 80286- and 80386-based PCs that allows real-mode application programs to use extended memory (plus certain areas of conventional memory not ordinarily managed by DOS) in a cooperative and hardware-independent manner. An installable device driver that implements the XMS is called an eXtended Memory Manager (XMM).

The XMS defines function calls that allocate, resize, and release memory blocks of three basic types:

- upper memory blocks (UMBs), which are at addresses between 640K and 1024K (1MB);
- the so-called "high memory area" (HMA), at addresses between 1024K and 1088K (more on this below);
- extended memory blocks (EMBs) from addresses above 1088K.

The XMS also provides hardware-independent control over the CPU's address line A20, which must be enabled to read or write extended memory. A summary of the XMS functions is presented in Figure 1, and you can obtain a copy of the eXtended Memory Specification, Version 2.0, dated July 19, 1988, by writing to Microsoft Corp., 16011 NE 36th Way, Box 97017, Redmond, WA 98073.

The XMS and Virtual Control Program Interface offer new ways to access extended memory.

USING XMS SUPPORT

HIMEM.SYS, Microsoft's own XMM, is installed by adding a `DEVICE=` line to the `CONFIG.SYS` file and rebooting the system. HIMEM.SYS accepts two optional switches:

`/MINMEM=n`

specifies the minimum number, *n*, of kilobytes in the high memory area (HMA) that a program can use (0-63, default = 0).

`/NUMHANDLES=n`



XMS EXTENDED MEMORY FUNCTIONS

FUNCTION	DESCRIPTION
Driver information	
00h	Get XMS version
High memory area management	
01h	Allocate high memory area
02h	Free high memory area
A20 line management	
03h	Global enable A20 line
04h	Global disable A20 line
05h	Local enable A20 line
06h	Local disable A20 line
07h	Query A20 line state
Extended memory block (EMB) management	
08h	Query free extended memory
09h	Allocate extended memory block
0Ah	Free extended memory block
0Bh	Move extended memory block
0Ch	Lock extended memory block
0Dh	Unlock extended memory block
0Eh	Get handle information
0Fh	Resize extended memory block
Upper memory block (UMB) management	
10h	Allocate upper memory block
11h	Free upper memory block

Figure 1: The functions defined by the Lotus/Intel/Microsoft/AST eXtended Memory Specification (XMS) permit use of DOS programs in extended memory.

Power Programming

sets the maximum number of XMS handles that can be active at any one time (0-128, default = 32).

A program can determine whether any XMM is available by setting AX to 4300h and executing an Int 2Fh. If the driver is present, the value 80h is returned in AL; if the driver is absent, AL is returned unchanged or with some other value. This convention differs from that used by the DOS extensions PRINT, SHARE, ASSIGN, and APPEND, which are also accessed via interrupt 2Fh (though with other values in AH, of course). They return AL = FFh if they are already installed.

Once it knows that the XMS driver is available, a program obtains the entry point of the driver by executing Int 2Fh with AX = 4310h. The entry point is returned in registers ES:BX. Entry point in hand, the program enters the driver by making a far call, without further recourse to interrupt 2Fh. A particular XMS function is selected by the value in AH; other parameters are passed in registers. At least 256 bytes of stack space should be available when you request an XMS function.

Most XMS functions return status information in register AX: 0001h if the

function succeeded or 0000h if the function failed. In the latter case, an error code is also returned in register BL, with the high bit set.

The steps a typical program takes to use an XMM to manage extended memory are as follows:

- Establish the presence of an XMM, using interrupt 2Fh. If an XMM is not present, the program must determine whether it can continue without extended memory or should attempt to allocate extended memory using the VDISK or interrupt 15h methods described in earlier columns.
- Allocate one or more extended memory blocks with XMS function 09h. The XMM returns a handle for each allocated block. (An extended memory block handle, like a file handle, is an arbitrary number, and its value has no direct relationship to the memory block's location.)
- Copy data between conventional memory and extended memory, using XMS function 0Bh. This function requires a parameter block that specifies the source and destination addresses in terms of a handle and a 32-bit offset. A nonzero handle refers to an allocated extended memory block, and the offset is from the base of that block. If the handle is zero, then conventional memory is being addressed and the 32-bit offset position contains a far pointer in standard Intel format.

■ Release extended memory block handle(s) with XMS function 0Ah before terminating. This ensures that the corresponding memory can be reused.

As an alternative to using XMS function 0Bh, the program can "lock" its extended memory block and obtain its current physical base address by using XMS function 0Ch. It can then use interrupt 15h function 57h to move data in or out of extended memory. When the program is finished accessing extended memory, it "unlocks" its block with XMS function 0Dh. This allows the XMM to move the block around in order to combine free blocks and satisfy other allocation requests.

Although it's not practical to document the entire set of XMS functions here, I want to provide a practical example of their use. Figure 2 contains the source code for an XMS-aware RAMdisk, called XMSDISK, which demonstrates the most-important XMS functions. You may wish to consult a general work on DOS programming as well, such as my own *Advanced MS-DOS*, for additional discussion of device driver structure and components. XMSDISK was tested with HIMEM.SYS, Version 2.04, dated 08/15/88.

To assemble and link XMSDISK.ASM into the executable device driver XMSDISK.SYS, you also need the files ATOL.ASM (PC Magazine, February 16,

XMSDISK.ASM

1 of 4

```

title          XMSDISK XMS-aware RAMdisk
page          55,132

; XMSDISK.ASM --- XMS-aware RAMdisk device driver
; Copyright (c) 1989 Cliff Davis Communications
; PC Magazine + Ray Duncan
; Also requires TROM.ASM and APLOT.ASM.

; To build:   LINK XMSDISK
;            LINK APLOT
;            LINK XMSDISK+TROM+XMSDISK.ASM
;            LINK XMSDISK.SYS

; To install: copy XMSDISK.SYS to the boot disk, add
;
;              DEVICE=XMSDISK.ASM  to the
;
; to the CONFIG.SYS file. This must follow
; the DEVICE= line that loads the ROM (usually
; HIMEM.SYS). The parameter rom is the desired
; RAMdisk size in KB. If rom is omitted or zero,
; all available extended memory is used.

_TEXT segment public 'CODE'
extern  atol_rear
extern  atol_rear

org     0
section '_TEXT', dw1 '_TEXT', 0x10000000
equ     0

named    equ     24          ; maximum driver command code

cr       equ     80h         ; ASCII carriage return
lf       equ     8ah         ; ASCII line feed
blnk     equ     255h        ; ASCII space code
eos      equ     '0'         ; end of message indicator

sectors  equ     512         ; bytes per sector (IBM standard)
dirsize  equ     256         ; entries in root directory

request  struc
len      db  ?              ; request packet template
unit     db  ?              ; length of request packet
unit     db  ?              ; unit number for this request
endstruc

command  db  ?              ; request packet's command code
status   db  ?              ; status returned by driver
media    db  0 dup (?)      ; reserved area
address   db  ?             ; media descriptor byte
count     db  ?             ; memory address for transfer
sector    db  ?             ; byte/sector count value
request   ends              ; starting sector value
                           ; end of request packet template

header   equ     0          ; device driver header
link     equ     -1         ; link to next driver
device    equ     0          ; device attributes word
device    equ     0          ; device "interrupt" entry point
unit      equ     1         ; device "interrupt" entry point
unit      equ     1         ; number of units, this device
reserved  equ     0          ; reserved (block drivers)
far       equ     0          ; far pointer to request packet
save      equ     0          ; save here! 80:07 during switch
to_driver equ     0          ; address of XMS entry point
handle    equ     0          ; handle for extended memory block
total     equ     0          ; total extended mem available (KB)
largest   equ     0          ; largest free block available (KB)
align     equ     0          ; extended memory alignment (KB)
align     equ     0          ; total clusters in RAMdisk
reference equ     0          ; current sector for transfer
reference equ     0          ; sectors successfully transferred
reference equ     0          ; number of sectors requested

array    dw  hpb            ; array of pointers to EPBs
                           ; for each logical unit

sectors  equ     0          ; IBM function 80h parameter block
length   equ     0          ; length to move in bytes
shandle  equ     0          ; source handle
offset    equ     0          ; source offset or far pointer
shandle  equ     0          ; destination handle
offset    equ     0          ; destination offset or far pointer

bootrec  equ     0          ; boot record for logical sec. 0
jap      equ     0          ; phy. JAP at start of boot
sector    equ     0          ; sector (max be 3200)
os        equ     0          ; OS identity field
size      equ     0          ; size Parameter block (SPB)
hpb       equ     0          ; # bytes per sector
hpb       equ     0          ; # sectors per cluster
hpb       equ     0          ; # reserved sectors

```

Figure 2: XMSDISK.ASM, the source code for an XMS-aware RAMdisk device driver, demonstrates the most-important XMS functions.

Power Programming

XMSDISK.ASM

2 of 4

```

db 1 ; 5 number of FATs
dw dirsize ; 6 root directory entries
dw dw ; 8 total sectors
dw fshb ; FAT medium descriptor byte
dw fshs ; FSH sectors per FAT
bootrec len equ $-bootrec ; length of boot record

even ; force word alignment
dw 128 dup (0)
strat equ 0 ; local stack for driver

; Driver 'strategy' routine; called by MS-DOS kernel with
; ES:BX pointing to driver request packet.

strat proc far ; driver 'strategy' routine
mov word ptr cs:rgrptr, bx ; save request packet address
mov word ptr cs:rgrptr+2, es ; back to MS-DOS kernel
ret

strat endp

; Driver 'interrupt' routine, called by MS-DOS kernel immediately
; after call to 'strategy' routine to process I/O request.

intr proc far
push ax ; save all registers
push bx
push cx
push dx
push si
push es
push di
push bp

mov ax, cs ; make local data addressable
mov dx, ax
mov savees, es ; save DOS kernel's stack
mov saveesp, sp
mov es, ax ; set SS:SP to point to
mov sp, offset strk ; (larger) local stack

lea di, rgrptr ; ES:DI = request packet
mov bx, es ; get BX = command code
cmp bx, maxcmd ; make sure it's legal
jle intr1 ; jump, function code is ok
mov ax, fshb ; return 'unknown command' error
jmp intr2

intr1: shl bx, 1 ; branch to command code routine
call word ptr [bx+dispch] ; must return AX = status
lea di, rgrptr ; ES:DI = request packet again

intr2: mov ax, $19bh ; merge 'done' bit into status
mov es:[di+status], ax ; store into request packet

mov es, savees ; restore DOS kernel's stack
mov sp, saveesp ; restore general registers

pop bp
pop si
pop di
pop dx
pop cx
pop bx
pop ax ; back to kernel

intr endp

; Dispatch table for driver commands

dispch db init ; 0 = initialise driver
dw medchk ; 1 = media check on block device
dw hldbpb ; 2 = build BIOS parameter block
dw error ; 3 = I/O control read
dw read ; 4 = read from device
dw error ; 5 = non-destructive read
dw error ; 6 = return current input status
dw error ; 7 = flush device input buffers
dw write ; 8 = write to device
dw write ; 9 = write with verify
dw error ; 10 = return current output status
dw error ; 11 = flush output buffers
dw error ; 12 = I/O control write
dw error ; 13 = device open (DOS 3.0+)
dw error ; 14 = device close (DOS 3.0+)
dw error ; 15 = removable media (DOS 3.0+)
dw error ; 16 = output until busy (DOS 3.0+)
dw error ; 17 = not used
dw error ; 18 = not used
dw error ; 19 = generic IOCTL (DOS 3.2+)
dw error ; 20 = not used
dw error ; 21 = not used
dw error ; 22 = not used
dw error ; 23 = get logical device (DOS 3.2+)
dw error ; 24 = set logical device (DOS 3.2+)

; Media check routine (command code 1). Returns code indicating
; whether medium has been changed since last access.
medchk proc near
mov byte ptr es:[di+14], 1 ; return 'not changed' code

```

```

mov ax, ax ; return success status
ret

medchk endp

; Build RPN routine (command code 2). Returns pointer to valid
; BIOS Parameter Block for logical drive.
hldbpb proc near
mov word ptr es:[di+20], cs ; put RPN address in packet
mov word ptr es:[di+18], offset hpb ; BIOS Parameter Block
mov ax, ax ; return success status
ret

hldbpb endp

; Read routine (command code 4). Transfers logical sector(s)
; from RAMdisk storage to specified address.
read proc near
mov ax, es:[di+sector] ; ES:DI = request packet
mov xfersec, ax ; save starting sector number
mov ax, es:[di+count] ; save sectors requested
mov xfercnt, 0 ; init sectors transferred count
mov ax, word ptr es:[di+address] ; requestor's buffer address
mov word ptr offset+2, ax ; destination handle = 0
mov ax, handle ; source handle = extended
mov shandle, ax ; memory handle
mov shandle, 0 ; destination handle = 0
mov word ptr movain, secsize ; logical sector length

read1: mov ax, xfercnt ; done with all sectors yet?
cmp ax, xferreq ; jump if transfer completed
je read2

mov ax, xfersec ; source offset =
mov bpb ; sector no. * bytes/sector
mov word ptr offset+2, ax ; sector no. * bytes/sector
mov word ptr offset+2, dx

mov ab, fshb ; move this sector from
mov si, offset movpaze ; save starting sector number
call xmm ; requestor to extended memory
or ax, ax ; any error?
je read3 ; yes, about transfer

inc xfersec ; advance sector and address
add word ptr offset+2, (secsize/16) ; count sectors transferred
jmp read1

read2: mov ax, ax ; return success status

read3: lea di, rgrptr ; get address of request packet
mov bx, xfercnt ; return sectors transferred count
mov es:[di+count], bx
ret

read4: mov ax, fshb ; XMM error, return 'read fault'
jmp read3

read endp

; Write (command code 5) and Write with Verify (command code 9)
; routines. Transfers logical sector(s) from specified address
; to RAMdisk storage.
write proc near
mov ax, es:[di+sector] ; ES:DI = request packet
mov xfersec, ax ; save starting sector number
mov ax, es:[di+count] ; save sectors requested
mov xfercnt, 0 ; init sectors transferred count
mov ax, word ptr es:[di+address] ; requestor's buffer address
mov word ptr offset+2, ax ; destination handle = extended
mov ax, handle ; source handle = extended
mov shandle, ax ; memory handle
mov shandle, 0 ; zero out source handle
mov word ptr movain, secsize ; logical sector length

write1: mov ax, xfercnt ; done with all sectors yet?
cmp ax, xferreq ; jump if transfer completed
je write2

mov ax, xfersec ; destination offset =
mov word ptr offset+2, ax ; sector no. * bytes/sector
mov word ptr offset+2, dx

mov ab, fshb ; move this sector from
mov si, offset movpaze ; requestor to extended memory
call xmm ; requestor to extended memory
or ax, ax ; any error?
je write4 ; yes, about transfer

inc xfersec ; advance sector and address
add word ptr offset+2, (secsize/16) ; count sectors transferred
jmp write1

write2: ; all sectors successfully

```

Power Programming

XMSDISK.ASM

3 of 4

```

xor     ax,ax                ; transferred, return ok status

write3:
    les     di,rpgrtr         ; get address of request packet
    mov     bx,xrarcnt        ; return actual transfer count
    mov     esi(di,ount),bx

write1:
    mov     ax,005ah          ; XMS error, return 'write fault'
    jmp     write3

write andp:
    ; Dummy routine for unsupported driver command codes
    error proc near
    mov     ax,0103h          ; return 'unknown command' error
    rat
    error andp

; Initialisation routine, called at driver load time. Returns
; address of 'init' label to M-DOS as start of free memory, so
; that memory occupied by 'init' and its subroutines is reclaimed.
init proc near
    mov     ax,4100h          ; check if XMS present
    int     2fh
    cmp     al,00h            ; status = installed?
    jne     init1              ; yes, proceed
    mov     dx,offset msg1     ; no, display error message
    jmp     init8              ; and abort installation

init1:
    mov     ax,4310h          ; XMS available, request entry
    int     2fh               ; point and save it

    mov     word ptr xms,bx    ; save XMS
    mov     word ptr xms+2,ax

    mov     ah,0              ; get available extended memory
    call    xms
    mov     total,dx           ; save total KB available
    mov     largest,ax         ; save largest free block
    cmp     ax,largest,64      ; at least 64 KB available?
    jae     init2              ; yes, proceed
    mov     dx,offset msg2     ; no, display error message
    jmp     init8              ; and abort installation

init2:
    les     di,rpgrtr         ; lat EBID = request packet
    lds     esi,esi:[di+16]    ; point to CONFIG.SYS line

init3:
    mov     al,blent          ; scan for end of driver name
    je      init3             ; loop while within name
    dec     si                 ; point to delimiter and
    call    etol               ; convert size parameter
    push    cs                 ; make our data addressable
    pop     cs
    mov     ax,ax             ; size parameter missing?
    jne     init4              ; yes, use all extended memory
    cmp     ax,largest         ; requested > available?
    jna     init3              ; no, jump

init4:
    mov     mov     ax,largest ; use all of available memory
    mov     alloc,ax           ; save requested size
    mov     dx,ax              ; set RAMdisk size in KB
    mov     ah,9               ; XMS function 9 = allocate
    call    xms                ; transfer to XMS
    or      jne     init6       ; allocation successful?
    mov     dx,offset msg3     ; yes, proceed
    jmp     init8              ; and abort installation

init5:
    mov     handle,dx          ; save extended memory handle
    mov     makabpp            ; set up BIOS Parameter Block
    call    format             ; format the handle
    jmp     init7              ; jump if no error during format
    mov     dx,offset msg4     ; formatting error, exit
    jmp     init8

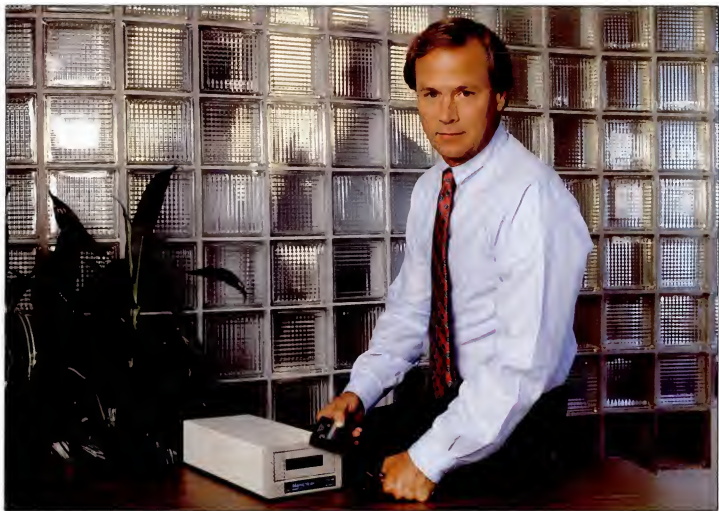
init6:
    les     di,rpgrtr         ; lat EBID = request packet
    mov     al,esi:[di+22]     ; get drive code from header,
    add     di,1               ; convert to ASCII for output
    mov     ax,total           ; convert KB available to ASCII
    mov     esi,offset ident2
    mov     cx,18              ; transfer to XMS
    call    itoa               ; convert KB largest free block
    mov     esi,offset ident3
    call    itoa               ; convert KB allocated to ASCII
    mov     esi,offset ident4
    call    itoa               ; transfer to XMS
    mov     dx,offset ident4   ; display sign-on message
    mov     ah,9               ; function 9 = display string
    int     21h               ; transfer to M-DOS

    mov     word ptr ax:[di,address],offset init ; set top of driver address
    mov     word ptr ax:[di,address+2],cs        ; set drive code from header,
    mov     byte ptr ax:[di+13],1               ; indicate 1 logical unit
    mov     word ptr ax:[di+20],cs              ; return address of BIOS array
    mov     word ptr ax:[di+18],offset array

init8:
    push    dx                ; XMSDISK initialization failed
    mov     dx,offset errmsg   ; save specific error message
    mov     dx,offset errmsg   ; display error handling

```

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Power Programming

1988) and ITOA.ASM (February 29, 1988). These subroutines convert ASCII strings into binary numbers, and vice versa. Gather the necessary files together and enter the following commands:

```
MASM XMSDISK;  
MASM ATOI;  
MASM ITOA;  
LINK XMSDISK + ATOI + ITOA;  
EXE2BIN XMSDISK, EXE XMSDISK.SYS  
DEL XMSDISK.EXE
```

(The Linker will display the message "Warning: No Stack Segment." This warning can be ignored.)

To install XMSDISK, add the line

```
DEVICE = XMSDISK.SYS nonk
```

to your CONFIG.SYS file and reboot the system. The parameter *nonk* is the desired size of the RAMdisk in kilobytes; if this parameter is omitted, XMSDISK will use all available extended memory by default. Make sure that the *DEVICE=* line for XMSDISK follows the *DEVICE=* line that loads your XMM (HIMEM.SYS, 386MAX.SYS, or whatever).

When XMSDISK is loaded, it displays a message and its drive identifier. If XMSDISK can't find an XMM, it will abort its installation with an error message.

THE HIGH MEMORY AREA

If you follow the trade press, you may remember the hoopla and claims of increased performance that surrounded the release of *Microsoft Windows/286*, Version 2.1. Microsoft declared that it had "found" an extra 64K of memory in which to put the *Windows* kernel. This new discovery enabled *Windows* to run much faster, since it drastically reduced the amount of segment swapping required.

The mysterious 64K of memory, which Microsoft dubbed the "high memory area" (HMA), is actually the first 64K of extended memory (less 16 bytes). While that explains the name change to *Windows/286*, I'm sure your mental alarm bells are already ringing. I've just spent the last two columns explaining how and why extended memory can be accessed only in protected mode. Since *Windows* is a real-mode program, how can it possibly execute code from extended memory?

The answer is at once extremely simple and devilishly clever. You'll probably consider it ridiculously obvious once you hear it. Before deprecating an unknown Microsoft programmer's stroke of insight, however, remember that tens of thousands of programmers used 80286-based PCs for 4 years without coming up with it!

Recall the method by which physical addresses are generated in real mode. The contents of a segment register are shifted left 4 bits and added to a 16-bit offset. On an 8086/88 machine, if the result overflows the 20-bit addresses supported by the CPU, the address simply wraps—that is, the upper bits are discarded. 80286- and 80386-based PCs can support larger physi-

cal addresses, but it provides a hardware-independent method of enabling or disabling the A20 line. This eliminates the need for programs to write directly to the ports that control the A20 line (possibly interfering with each other, especially in the case of interrupt handlers), and it ensures that the toggling of the A20 line is done in the most efficient way. Second, it arbitrates the use of the high memory area between programs.

The management of the high memory area is not very complex, since the HMA is small and is always allocated as a unit. A device driver or memory-resident program that uses the HMA should store as much of its code there as possible, for the remainder will be unavailable to other programs. Thus, if a driver or TSR cannot exploit nearly all of the HMA, it should leave the whole HMA available for use by subsequently loaded programs. The user can enforce such "good behavior" by using the /HMAMIN switch, which causes allocation requests for the HMA to fail if they are smaller than the amount specified.

Device drivers and TSRs must not leave the A20 line permanently turned on. There are some brain-damaged applications that rely on the wrapping of memory addresses at the 1MB boundary, and so will blithely overwrite the HMA if the A20 line is left enabled. Similarly, interrupt vectors must not point directly into the HMA, since the A20 line may not be enabled when the interrupt is received.

If the HMA is available when a normal application runs, the application is free to use as much or as little of the HMA as it wishes, subject to these restrictions:

- Far pointers to data located in the HMA cannot be passed to DOS (DOS "normalizes" pointers in a manner that invalidates HMA addresses).

- Disk I/O directly into the HMA by any method is not recommended (the behavior of some clone disk controllers may vary).

An application that allocates the HMA must also be sure to release it before terminating. Otherwise, the HMA will be unavailable for use by any other programs until the system is restarted.

THE VCPI

The Virtual Control Program Interface (VCPI) was developed by Phar Lap Software and Quarterdeck Office Systems. Phar Lap Software is a vendor of excellent 80386 programming tools, including the linker used by nearly every other manufacturer of an 80386-specific compiler or application for DOS. Quarterdeck, of

Since *Windows* is a real-mode program, how can it possibly execute code from extended memory?

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cal addresses (24 bits and 32 bits, respectively), but this capability is ordinarily not apparent when DOS is running. That's because these machines have special hardware to disable the most-significant address lines in real mode, making the machine behave more like an 8088.

Consider what happens, however, on an 80286 when you enable the A20 line and place the value FFFFh in one of the segment registers. Enabling the A20 line allows the generation of 21-bit physical addresses. And when FFFFh is shifted left 4 bits and added to a 16-bit offset, the result will fall in the address range FFFF0h-10FFEFh. In other words, enabling the A20 line allows the first 65,520 bytes of extended memory to be addressed without leaving real mode.

The XMS specification makes use of the HMA "discovery" in two ways. First,

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[illegible]

course, is the developer of *DESQview*, a multitasking user interface that sits on top of DOS. The VCPI has subsequently been adopted by A.I. Architects, Quadram, Qualitas, and Rational Systems, four other important 80386 software vendors.

The VCPI addresses problems peculiar to extended memory management on 80386 machines, so it is irrelevant to 80286-based PCs. There are basically three classes of programs being sold in the DOS market today that take advantage of the 80386's unique capabilities. "DOS extenders" let programs run in the 80386's 32-bit protected mode but still use DOS for I/O. "EMS emulators" exploit the 80386's page-mapping hardware to make extended memory act like expanded memory (LIM EMS). "Virtual machine monitors" use the 80386's virtual 86 mode to multitask DOS applications.

All three types of 80386-specific performance boosters work fine taken alone but they can come into conflict if you try to use two or more of them at the same time. Problems arise, for example, if you load an application such as *Paradox386* when you have already loaded Compaq's *CEMM.SYS* or Quarterdeck's *QEMM.SYS* expanded memory simulator. This is

because all three program types are actually little protected-mode operating systems that run at the CPU's highest privilege level and manipulate all sorts of vital registers and data structures that are irrelevant in DOS's familiar old real mode. The 80386 doesn't appreciate having two protected-mode operating systems simultaneously competing for its attention.

Proper use of the VCPI requires understanding the 80386's protected mode.

The VCPI provides a protocol that permits 80386-specific protected-mode applications to cooperate with each other. The programs communicate via interrupt 67h—the same software interrupt used by LIM EMS drivers. The first-loaded 80386 control program is responsible for hooking

this interrupt and monitoring for a specific function number that is not defined under the original LIM EMS. Other 80386 control programs can then invoke the special interrupt 67h function to request memory mapping, CPU mode switching, and similar services from the first.

The XMS and the VCPI extended memory managers are not necessarily mutually exclusive. For example, the latest version of Qualitas's *386-to-the-Max* supports the VCPI and all the functions defined by the Lotus/Intel/Microsoft/AST XMS and the Lotus/Intel/Microsoft Expanded Memory Specification (EMS).

Proper use of the VCPI requires an understanding of 80386 protected mode that is far beyond the scope of this column. However, you can obtain a copy of the VCPI Specification from Phar Lap Software Inc., 60 Aberdeen Ave., Cambridge, MA 02138: (617) 661-1510.

THE IN-BOX

Please send your questions, suggestions, and comments to me at any of the following e-mail addresses:
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**EDITOR'S
CHOICE**



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Spreadsheet Clinic

AUTO-EXECUTING MACROS

The documentation that comes with *Microsoft Works* does not contain instructions on how to create an auto-executing macro. To do so, within the directory that contains *MS-Key* (*Works*' macro program), you can create a four-line batch file similar to the one shown in Figure 1. The first line should be in the form

```
MSKEY / [open filename]
```

where *filename* is the name of the file that contains the macro that you want *Works* to execute. If this file is in a directory other than the one that contains *MS-Key*, be sure to preface the name of the file with the path to that directory.

The second line should be in the form

```
MSKEY / <esc>key
```

where <esc> represents ASCII character 27 (the escape character) and *key* is the key or combination of keys to which the macro is linked. To specify the escape character, press Ctrl-V, and then type [. This places the characters ^V[on the DOS command line.

Unfortunately, many of the key combinations to which you can link a macro cannot be represented on a DOS command line. However, most Ctrl-<key> combinations can be represented on a DOS command line, so I link my auto-executing macro to the Ctrl-A combination. To specify this character in the batch file, I simply press Ctrl-A. This key combination places the characters ^A to the right of the [character

MICROSOFT WORKS BATCH FILE

```
MSKEY / [open c:\works\automacs]
MSKEY / [^O
cd works
works
```

Figure 1: This batch file commands *MS-Key* to execute the macro that is linked to the Ctrl-A combination as soon as *Microsoft Works* has been loaded.

■ **AUTO-EXECUTING MACROS:** Here's a technique for creating auto-executing macros in *Microsoft Works*.

■ **REPLACING CELL REFERENCES:** The **Abs** key allows you to replace cell references with range names when you are editing a formula.

■ **ENTER DATES EASILY:** A simple macro makes it as easy to enter dates in 1-2-3 as it is in *Quattro*.

■ **THE % OPERATOR:** 1-2-3 will not accept formulas that reference a cell in column E after a % operator. Here are some ways around this problem.

REPLACING CELL REFERENCES

When you move the cell pointer to a cell that contains references to one or more named ranges, 1-2-3 displays those names in the formula that appears on the Control Panel. When you bring that formula to the Edit line, however, 1-2-3 replaces the range names with cell references.

Fortunately, I've found a way to get the more informative range names back even after you've hit the Edit key. Simply move the blinking underline cursor to the reference that you want to replace, and press F4—the **Abs** key. If the cell or range specified by the current reference has a name, 1-2-3 will replace it with that name. Additionally, if the reference is relative, 1-2-3 will preface the range name with a dollar sign (\$), indicating that it has made the reference absolute. If the reference is mixed or absolute, 1-2-3 will make it relative.

Suppose, for example, that the cell pointer is on a cell containing the formula

```
@SUM(A1..A5)+$B$1$
```

and that cells A1..A5 and B10 are named ONE and TWO, respectively. Before you press the Edit key, 1-2-3 will display

```
@SUM(ONE)+$TWO
```

at the top of the screen.

When you press Edit, however, the Edit line will contain the first inset line above, not the second. But if you position the cursor under the reference to cell B10 and press **Abs**, then reposition the cursor under the range reference A1..A5, and hit **Abs** again, the Edit line will show the formula as

```
@SUM($ONE)+TWO
```

Deleting the dollar sign ahead of the reference to the range name ONE and adding one in front of the range name TWO makes this formula equivalent to the one that was in the cell originally.

Kevin Patterson
Springfield, Missouri

on the second line of the batch file.

The third line of the batch file should switch you to the directory that contains your *Works* program files. The final line should contain the filename *WORKS*. This command loads the *Works* program.

The macro specified in the second line of the batch file can do something as simple as opening a document, or something as complex as creating and printing a database report.

Thomas L. Ramey
Richmond, Virginia



Mr. Ramey's technique should prove valuable to advanced users of *Microsoft Works*. Note that the escape character that precedes the key to which the auto-executing macro is linked delays the execution of that macro until *Works* has been loaded.

Spreadsheet Clinic

PC Mr. Patterson is right. When *1-2-3* is in the Edit mode, the Abs key replaces references to named cells and ranges with the names of those cells or ranges. It will also change the reference from relative to absolute, or from absolute or mixed to relative. (If the cell or range does not have a name, the Abs key will have the same effect it has when *1-2-3* is in the Value or Point modes. That is, it will toggle the reference between the relative, absolute, and two mixed forms.)

The macro shown in Figure 2 also brings formulas to the Edit line in range-name form. The first statement in this macro commands *1-2-3* to recalculate the string formula in the next cell of the macro. This formula

```
B2: +=[Contents] ENTRY, *
    &@CELLPOINTER("address")&*, 240, 117)
```

returns a valid {Contents} command that instructs *1-2-3* to place into the cell named ENTRY (B6) a label that looks like what would appear in the current cell if it were 240 characters wide and had been assigned the Text format.

To illustrate, if the cell pointer was on cell A7 when you invoked this macro, the formula in cell B2 would return the string

```
[Contents] ENTRY, A7, 240, 117)
```

And if cell A7 contained the formula

```
=SUM(A1..A5)+$B$10
```

and cells A1..A5 and B10 were named ONE and TWO, respectively, this statement would place the 240-character label

```
B6: +=[Contents] @SUM(ONE)+TWO
```

RANGE NAME MACRO					COMPLETE LISTING
	A	B	C	D	E
1	\e	{Recalc NEXT}			
2	NEXT	{Contents ENTRY, \$A\$1, 240, 117}			
3		{Let ENTRY, @TRIM(ENTRY)}			
4		{ENTRY} {Edit}			
5					
6	ENTRY				
7					

Figure 2: This macro brings *1-2-3* formulas to the Edit line with their more informative range names instead of cell and range references.

CTRL-D MACRO

COMPLETE LISTING

```
1  \d      A      B      C      D      E
2          {?}
3          {WindowsOff}{PanelOff}
4          "{Edit}{Home}@DATEVALUE(" -
5          /rfd4"
6          {WindowsOn}{PanelOn}
```

Figure 3: This *1-2-3* macro duplicates the effect of the Ctrl-D combination in *Quattro*.

into cell B6. (Note that this label has 226 trailing spaces.)

After entering this label into ENTRY, *1-2-3* executes the statement in cell B3, which removes all trailing spaces from the label in ENTRY. At that point, the characters stored in ENTRY (the range-name form of the formula) are typed onto the Edit line, as instructed by the subroutine call {ENTRY}, and *1-2-3* is switched into the Edit mode.

PRODUCTIVITY TIP

To freeze the screen during the execution of a *1-2-3* macro and avoid the tedium of typing the {WindowsOff} and {PanelOff} commands, place them in a subroutine named Off. Similarly, place the commands {WindowsOn} and {PanelOn} in a subroutine named On. This way, you can use the subroutine call {OFF} to freeze the screen, and the subroutine call {ON} to unfreeze it.

ENTER DATES EASILY

Quattro allows you to enter a date in mm/dd/yy form (Date 4 format) quickly and easily by pressing Ctrl-D before typing the date. When you then type the date and press Enter, *Quattro* puts the serial value of that date into the current cell and assigns that cell the Date 4 format. For example, if you were to hit Ctrl-D, type 12/31/88, and hit

Enter while the cell selector is on cell B2, *Quattro* would enter the date's serial value (32508) but display it more intelligibly as /12/31/88 (Date 4 format).

Unfortunately, *1-2-3* does not provide this handy feature. Since I work a lot with both *1-2-3* and *Quattro*, I wanted to be able to duplicate this feature in *1-2-3*. I therefore created the macro shown in Figure 3. This macro makes entering a date into *1-2-3* as easy as it is in *Quattro*.

The pause created by the first statement in the macro allows you to enter the date in the desired mm/dd/yy form. When you hit Enter, *1-2-3* continues, but since the {?} command is not followed by a tilde (~), the entry is not locked into the worksheet. Instead, it remains on the Edit line when the screen is frozen by the second line in the macro.

Finally, the third statement adds the necessary punctuation characters and an @DATEVALUE function to the date on the Edit line. It then presses the Enter key, which in turn locks that function into the current cell of the worksheet. At that particular point, *1-2-3* assigns the Date 4 format to the cell that contains the function, unfreezes the screen, and ends the execution of the macro.

John D. Thomason
Chattanooga, Tennessee

PC To make this macro work exactly like *Quattro*'s, you should insert a {Calc} command ahead of the tilde in the statement in cell B3, as shown below:

```
B3: += {Edit}{Home}@DATEVALUE({Calc} "
```

This will tell *1-2-3* to recalculate the @DATEVALUE function while it is still on the Edit line. That way, *1-2-3* will lock the result of the function (rather than the function itself) into the current cell, just as *Quattro* does.

Spreadsheet Clinic

THE % OPERATOR

Recently, I encountered a strange behavior of 1-2-3 that I can't explain. I needed to enter a formula that multiplied the value in cell E1 by 10% into a cell of a worksheet. To do this, I typed the formula $10\%*E1$. When I pressed the Enter key, 1-2-3 beeped instead of entering the formula into the worksheet. I replaced the E with a different single letter and 1-2-3 accepted the formula.

1-2-3 won't accept a formula if a column reference beginning with E is preceded by a value, a percent sign, and any mathematical operator.

When I experimented further, I realized that this problem occurs whenever a column reference beginning with E is immediately preceded by a value, a percent (%) sign, and any mathematical operator (+, -, *, /, or ^). This includes column E and columns EA..EZ. For example, 1-2-3 will not allow you to enter any of the following formulas:

$5\%*E15$
 $13\%-E6237$
 $28\%*E61234$
 $37\%/E5539$
 $52\%^E123$
 $123+75\%*E6333$

Fortunately, you can work around this problem. There are ways to enter formulas containing a reference to a cell in column E and a value in percent form. 1-2-3 will accept formulas of this sort if the reference precedes the value. For example, 1-2-3 will accept the formula $+E10*10\%$. When you type this and press Enter, 1-2-3 will enter the formula $+E10*0.1$ into the current cell.

Note that 1-2-3 converts the value from percent form to decimal form as it enters the formula into the cell.

Another method for solving this problem is first to enter a formula referencing a cell in a column other than E or EA..EZ. Then bring the formula back to the Edit line and replace the reference with a reference to a cell in a column beginning with E. For example, to enter the formula $10\%*E1$, type $10\%*D1$ and press Enter. Next, press Edit (to bring the formula $0.1*D1$ to the Edit line), and then replace the D with an E. Since the value .1 will be in decimal rather than percent form, 1-2-3 will accept the formula (in this case, $0.1*E1$) when you subsequently press Enter.

R. K. Schmitt
Kalamazoo, Michigan



Although we're not sure why 1-2-3 behaves in this strange way, we'll venture a guess. 1-2-3 allows you to enter values in the form xEy , where x is the value that you want to multiply by a power of 10 and y is the power of 10. If you type $2E3$ and press Enter, 1-2-3 will lock the value 2,000 ($2*10^3$) into the worksheet.

In this case, 1-2-3 may be interpreting the letter E as denoting an exponent, rather than a reference to a cell in column E. 1-2-3 balks because the E is preceded by an operator, rather than a value. If you insert a value to the left of the E, 1-2-3 will accept the formula. For example, the formula $10\%*1E1$ will return the value $1*10^1=1$. Of course, this is not the result you want.

In addition to the two ways Schmitt suggests to deal with this bug, you can precede the reference to the cell in column E with a plus sign. For example, to multiply the value in cell E3 by .1, you could enter $10\%*+E3$; to add the two values in the cell, you could enter $10\%+ +E3$, and so forth. Fortunately, few 1-2-3 users will ever have to confront this troublesome problem.

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CIRCLE 742 ON READER SERVICE CARD

by
Noli A. Rubenking

User-to-User

COMMAND CHECK

Sometimes when I enter a command I misspell a filename, omit a file extension, or don't specify the correct directory path. Of course, it usually happens at a critical time, such as when I start a long operation with many filenames and then leave to do something more important (and more interesting) than baby-sit the execution. And as Murphy's Law would have it, the longest file is usually the one I misspell. So I wrote the batch file CHECK.BAT, shown in Figure 1.

CHECK.BAT does nothing more than check for the existence of each specified file in the directory that's active when you give the command. If it doesn't find all the files you specified, you have the opportunity to edit the command. Use either your function keys or a command line editor that lets you retrieve and edit a command from a stack of recently entered ones.

Let's suppose you enter

```
CHECK FILE1.TXT FILE2.TXT FILE3.TXT
```

and both FILE1.TXT and FILE3.TXT are found but FILE2.TXT is missing. In this case, CHECK.BAT would display

```
ECHO OFF
***
*** CHECKING FOR PRESENCE OF FILES ***
*** IF NOT FOUND, Check the CURRENT
Path!!
***
FILE1.TXT FOUND!
FILE2.TXT NOT FOUND ***** ERROR
FILE3.TXT FOUND!
```

followed by the DOS prompt. Now you can retrieve and edit the command line, inserting the correct spelling of the file that you typed as FILE2.TXT, and try again. If you included an entry that isn't a filename (for example, a parameter required by your command), you will get a NOT FOUND message, but everything else works fine.

When the file list is correct, type PRINT, press F3 to retrieve the remainder of the previous command line, and hit Enter. Ev-

■ **COMMAND CHECK:**
Don't waste time on mistyped commands—
CHECK them first

■ **UNPROTECT**
PROGRAMS: How to
unprotect programs
written in a non-IBM
version of BASIC

■ **ACTIVATE CTL-PRTS:**
Flip DOS's printer echo
toggle from within your
batch files

■ **SUBST DRIVES:** A batch
file that assigns a SUBST
drive to the current
directory

CHECK first you don't have to reprint the entire set of files until you get it right.

CHECK.BAT starts by identifying itself and reminding you that the path used is the current path, which may not be the one you thought it was. This could be important if the CHECK command is issued when you are working from a subdirectory.

NEXT establishes a label for the loop used to check each file in turn. SHIFT moves each filename into the leftmost (or %0 parameter) position. This lets CHECK examine a series of parameters with the same batch code instead of coding a long series of IFs to cover all possible situations.

The two IFs handle each filename as it is shifted into the leftmost position. The first IF tests to see if any parameters remain; if not, it is done and can go to QUIT to exit the batch file. The second IF checks the status of the file as specified on the command line. You could change it to

```
IF EXIST %0 GOTO NEXT
```

anything should print correctly.

This batch file is especially useful if you need to print a list of files making up a program or document and you want the files printed in a particular order. By using

and get a list of only what is missing, but I prefer to see the list for a final review and to get some feedback on the CRT screen that the list was checked completely.

CHECK.BAT

```
ECHO OFF
REM CHECK FOR PRESENCE OF EACH FILE.
REM LET'S YOU VERIFY EXISTENCE OF FILES PRIOR TO SUBMITTING
REM BATCH COMMANDS SUCH AS PRINT AND DISCOVERING LATER THAT
REM YOU TYPED A FILE NAME WRONG.
REM RUN THIS AND THEN USE F-keys OR EQUIVALENT TO CHANGE
REM "CHECK" TO DESIRED COMMAND.
REM
ECHO ***
ECHO *** CHECKING FOR PRESENCE OF FILES ***
ECHO *** IF NOT FOUND, check the current Path!!
ECHO ***
:NEXT
SHIFT
IF "%0"==== GOTO QUIT
IF EXIST %0 GOTO FOUND
ECHO %0 NOT FOUND ***** ERROR
GOTO NEXT
:FOUND
ECHO %0 FOUND!
GOTO NEXT
:QUIT
```

COMPLETE LISTING



Figure 1: CHECK.BAT quickly checks for the existence of a series of filenames.

User-to-User

If you type perfectly, you won't need this batch routine. But everyone else needs a little help some days.

Doug Smith
Vincentown, New Jersey



This is how you use CHECK.BAT: first run CHECK on your list of filenames. If they're correct, type in the name of the *actual* program you want to run and then press F3 to retrieve the remainder of the previous command line. You will have a problem if the name of the actual command is longer than the word CHECK, though. To avoid this, either leave four spaces between the word CHECK and the first filename or rename CHECK.BAT to an eight-letter filename like CHECKFIL.BAT.

The author states that CHECK will look for files in the current subdirectory. Actually, you're free to specify full pathnames—CHECK looks in the current directory only for files that have no path specified. You can also use wildcard file-specs. CHECK will report a "FOUND" if at least one file matches. For example, this is a possible command line:

```
CHECK C:\F00.BAR *.XYZ C:\DOS
VFORMAT.COM
```

However, CHECK.BAT is most useful when checking the existence of particular (that is, nonwildcard) filenames.

UNPROTECT PROGRAMS

I have a way to unprotect a BASIC program saved with the P option that I haven't seen published anywhere else. The BASIC interpreter can be modified using DEBUG. Figure 2 lists this information for some of the BASIC interpreters I've used. The code for the IBM BASIC interpreter is located in ROM and not directly modifiable.

The locations of the protection flag and the code to be changed will vary with different versions of the interpreter. After this change, the interpreter will handle a protected program like an unprotected one.

Wayne Orr
Tulahoma, Tennessee



A number of our readers have pointed out to us that the unprotect method in the November 29, 1988, issue works only for IBM BASIC.

BASIC PATCH

COMPLETE LISTING



Zenith BASIC 3.13

XXXX:AD94

OLD CODE

MOV AL, [0599]

OR AL, AL

NEW CODE

XOR AL, AL

MOV [0599], AL

Compaq BASIC 2.11

XXXX:A09B

MOV AL, [04CC]

OR AL, AL

XOR AL, AL

MOV [04CC], AL

Compaq BASIC 3.11

XXXX:A644

MOV AL, [0599]

OR AL, AL

XOR AL, AL

MOV [0599], AL

Figure 2: Patch the BASIC interpreter so you can unprotect programs saved with the P option.

I'm very pleased to be able to present readers with an alternative. Of course, each version of BASIC will require its own patch, but at least we now know that such a patch is possible.

ACTIVATE CTL-PRtSc

There are lots of programs that interpret extended ASCII keys and scan codes. However, there aren't very many that will gener-

issue the following command:

```
DEBUG < TURNPRN.DBG
```

TURNPRN.COM simply inserts the Ctrl-PrtSc code directly into the keyboard buffer and resets the tail and head pointers. The code is then read by DOS automatically.

7200 (line 6) is the extended ASCII code for Ctrl-PrtSc. The trailing 00 indicates that the key-combination is an extended ASCII code. To use this for other extended codes, change the name of the .COM file and replace 72 with the appropriate code.

Dana Bell
Tyler, Texas

TURNPRN.COM COMPLETE LISTING

N TURNPRN.COM

A100

MOV AX, 40

MOV DS, AX

MOV BX, 1E

MOV WORD PTR[BX], 7200

MOV BX, 1C

MOV BYTE PTR[BX], 20

MOV BX, 1A

MOV BYTE PTR[BX], 1E

INT 20H

RXC

1A

W

Q



Figure 3: This DEBUG script creates TURNPRN.COM, a tiny program that toggles DOS's printer echo on and off.

ate the extended ASCII keys. TURNPRN.COM is a program that activates Ctrl-PrtSc, the DOS printer echo, and that can be included in any batch file. In order to generate the program, you must first create the DEBUG script file that is shown in Figure 3 with a pure ASCII word processor. Then, from the DOS command prompt, you

When the Ctrl-PrtSc toggle is active, anything that's written to DOS Standard Output goes to the screen and to the printer. You may find this handy in your batch files. I created TURNDEMO.BAT (Figure 4) as a minor demonstration of the use of TURNPRN.COM.

When you create the DEBUG script for TURNPRN, be sure to copy it exactly. Don't forget the blank lines before RCX and after the final Q. And be sure to use an editor that can create a flat ASCII file with no control characters and with carriage return and line feed characters at the end of every line. The venerable EDLIN.COM is perfectly suitable for small files like this.

Please note that you probably can't use modifications of the TURNPRN.COM program to bring up hotkey-activated RAM-resident programs. These programs almost invariably check the keyboard port before any information gets put into the keyboard buffer.

User-to-User



PRODUCTIVITY TIP

It's easy enough to create a small file by copying the CON device to a filename. For example,

COPY CON MYFILE

But what if you want to add some lines to MYFILE? You could COPY CON and re-type the whole thing plus the new lines; however, the statement

COPY MYFILE+CON

will accomplish the same thing. Be sure to type a carriage return at the end of the last line in MYFILE.

SUBST DRIVES

Although many people use the shorthand notation of two periods (..) to switch to a parent directory, most of them fail to realize the enormous usefulness that . and .. can have. These shorthand notations can represent either all of the files in a specified directory or the directory location itself. This flexibility allows . and .. to be used for more than directory changing. For example,

SUBST [drive].

This is a neat trick; on a drive with an extensive subdirectory structure it can save you a great deal of time. DOS will substitute the current directory location for the period, and from that point forward, the directory that

SUBSTDOT.BAT

COMPLETE LISTING

```
ECHO OFF
IF "%1"=="" GOTO NoParam
FOR %v IN (E: F: a: f:) DO IF %1==%v GOTO InUse
SUBST %1 /D > NUL
SUBST %1 .
%1
CLS
ECHO IF you're not in SUBSTed drive "%1" now, either you gave
ECHO an erroneous parameter OR your LASTDRIVE line in CONFIG.SYS
ECHO fails to specify a value of at least "%1".
GOTO End
:NoParam
ECHO SYNTAX: "SUBSTDOT d:", where d: is the drive letter to use.
GOTO End
:InUse
ECHO The drive letter "%1" is in use.
:End
```

Figure 5: This batch file will assign the drive letter of your choice to the current directory.

Although many people
use the shorthand
notation of two
periods (..) to switch
to a parent directory,
most of them fail to
realize the enormous
usefulness that . and
.. can have.

was current when the command was issued will be assigned a logical drive letter.

Files that appear in two directories can be very quickly and easily compared, copied, and moved by replacing a long path (represented by the period) with a single drive letter.

Timothy Dyck
Pentticon, British Columbia



We've covered the uses of . and .. frequently in this column, but using . with SUBST is new. I've created SUBSTDOT.BAT, shown in Figure 5, that will instantly assign the current directory to a drive letter of your choice. Before you can use SUBST, your CONFIG.SYS must have a line that says

LASTDRIVE=D

where n is the highest drive letter you want to be able to SUBST.

SUBSTDOT.BAT assumes that you're already using some SUBSTed drives, in this case E: and F:. You wouldn't want to accidentally eliminate your standard SUBST drives, so the batch file checks for those letters and refuses to SUBST them. Of course, you will include whatever letters are appropriate for your own system.

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TURNDEMO.BAT

COMPLETE LISTING

```
ECHO OFF
ECHO This batch file toggles the echo-to-printer feature
ECHO on and off. Be sure your printer is ready, then
PAUSE
TURNPRN
DIR
TURNPRN
ECHO That directory was displayed on your screen AND on
ECHO the printer.
```

Figure 4: TURNDEMO.BAT demonstrates the use of TURNPRN.COM. Activating the Ctrl-PrtSc toggle will send anything written to DOS standard output to your screen and printer.



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edited by
Craig L. Stark

Power User

SAVE TIME PRINTING MULTIPLE COPIES

When you request more than one copy of a document in WordPerfect, the program re-sends the document text to the printer many times. This process can be very time-consuming, especially when graphics are involved.

If you're fortunate enough to be using a PostScript-compatible printer, however, there's a much easier way to get multiple copies. You should include the printer command `/#copies n def` where *n* is the number of copies required somewhere on every page. To enter a printer command in WordPerfect, Version 5.0, the key sequence is Format (Shift-F8), Other, Printer, Printer command, Command. In Version 4.2 it's Print Format (Ctrl-F8), A. Note that there is a space after the `def`. The simplest place to put the printer command is in a header or footer—that way you need physically enter it only once at the beginning of the document—but the command can go anywhere on the page. It simply must appear on every page of which multiple copies are required.

The method described above will produce multiple copies of each page in turn; for example, ten copies of page 1, ten copies of page 2, and so on, unlike WordPerfect's "multiple copy" option, which produces only repeated copies of the whole document. This can be many times faster when the document comprises mixed text and graphics.

J.R. Drummond
Weston, Ontario
Canada

PC As you probably know, printers can take quite a long time to interpret the PostScript commands that create a page of text and graphics. But once a page has been processed, they can print multiple copies of it at full speed. This tip could save you literally hours if you must make multiple copies of large text-and-graphics documents.—Neil J. Rubenking

■ SAVE TIME PRINTING MULTIPLE COPIES:

A PostScript-compatible printer can duplicate large WordPerfect documents—fast.

■ A GENERIC PICTURE FUNCTION: A nul and @S perform as universal PICTURE functions in Clipper procedures.

■ FOOTNOTE FLEXIBILITY: Here's a way to gather footnotes, edit and return them to the original document.

■ TEMPORARY MACROS: WordPerfect 5.0's temporary macro feature is great for one-shot macro commands.

A GENERIC PICTURE FUNCTION

Because flexibility is critical in highly procedure-laden programs, people often pass a memory variable for the PICTURE functions of a GET statement. This technique allows the procedure to function correctly in a wide variety of situations.

But what if, in special situations, you want the GET to perform in its native, unPICTURED state—that is, as if no PICTURE function were present? Or what if, for some reason, you don't know the GET's field type and therefore can't create a legal PICTURE function?

The solution is to pass the one universal PICTURE function: a nul. Thus, if you want the user to respond by entering the value

for a memory variable, *ansr*, but in the context of this program, you don't know *ansr*'s field, just type

```
DO unipict WITH ansr.[]
```

where unipict is a procedure such as

```
PROC unipict  
  PARA curvar, currpict  
  @ 1. GET curvar PICT currpict  
  READ
```

Francis Edler
Phoenix, Arizona

PC Mr. Edler's "universal picture" for Clipper works equally well in dBASE and FoxBASE. When PICTURE [] is encountered, it works as well as character types.

Interestingly, the nul is not the only universal picture. The @S function, which normally includes a number to indicate width, is equally effective if the number is omitted. In Clipper and dBASE (but not FoxBASE), a bald @ also works.—Brad Stark

FOOTNOTE FLEXIBILITY

WordPerfect Version 5.0's footnoting function does not allow the user to examine or edit the footnotes all at once. This is frustrating when you must make major punctuation changes in order to conform to a particular style manual.

To solve this problem, I have created the four macros shown in Figure 1. FOOTEDIT.WPM, which uses the additional macro FOOT.WPM, collects all of the footnotes in the document and moves them into document 2, where they can be edited.

FOOTNEW.WPM, in conjunction with FOOTREP.WPM, puts the edited footnotes back into the original document. An additional benefit of using these macros is that it gives you the ability to print your footnotes as a unit and check them.

To use the FOOTEDIT.WPM macro, load the document into screen 1, make

Power User

sure screen 2 is empty, press Alt-F10, type FOOTEDIT, and press Enter. Switch to document 2 and edit the notes, making sure you do not delete the @ mark that separates them. You cannot remove or add footnotes when you edit. When you're finished editing, you can activate the macro FOOTNEW.WPM from screen 2 and the footnotes will be updated. You have to hit F1 (cancel) when the macro is done to turn the blocking feature off in screen 2. All four macros must be in the default directory, and I strongly recommend that you use them on a backup copy of the file.

It would not be hard to convert these macros to provide another function missing in WordPerfect 5.0—namely, the ability to convert footnotes into endnotes or vice versa.

Jonathan Weinberg
Jersey City, New Jersey



You should definitely follow the author's advice and use this set of macros on a copy of your file. FOOTEDIT.WPM actually deletes the contents of each footnote as it copies it to document 2. That's necessary so that it can replace the edited footnotes afterward, but it leaves your text in a vulnerable position. Note also that you should not do any other editing before replacing the edited footnotes. If you were to delete a footnote in the text, all the others after it would be out of sync.

You may find that you need to use the @ symbol in your footnotes. In such a case, just edit FOOT.WPM and FOOTREP.WPM, replacing the @ symbol with a code string like ~% 1. Just be sure to add enough Backspace codes in FOOTREP.WPM to erase the entire code string.

—Neil J. Rubenking

TEMPORARY MACROS

WordPerfect users are likely to know about two ways of defining macros: with one-to-eight-character names or with Alt-key combinations. However, WordPerfect 5.0 has added a third type, a "temporary" macro, which is created simply by hitting Enter when prompted for a macro name after pressing Ctrl-F10. Although the Reference Manual states that the temporary macro is erased when you exit the program, it remains on the disk under the name WP[WP].WPM. Here's a way to put this

FOOTNOTE MACROS

```
<Ctrl-F10>
FOOTEDIT<CR>
<Shift-F3>
<Home><Home><Up>
<CR>
<Shift-F3>
<Home><Home><Up>
<Alt-F10>FOOT<CR>
<Ctrl-F10>
```

```
<Ctrl-F10>
FOOT<CR>
<Ctrl-F7>fe<CR>
<Right><Alt-F4>
<Home><Home><Down>
<Del>
<Shift-F3>
<F1>r
@<CR>
<Shift-F3>
<F7>
<Alt-F10>FOOT<CR>
<Ctrl-F10>
```

```
<Ctrl-F10>
FOOTNEW<CR>
<Home><Home><Up>
<Shift-F3>
<Home><Home><Up>
<Shift-F3>
<Alt-F10>FOOTREP<CR>
<Ctrl-F10>
```

```
<Ctrl-F10>
FOOTREP<CR>
<Alt-F4>
<F2>@<F2>
<Ctrl-F4>hc
<Shift-F3>
<Ctrl-F7>fe<Enter>
<Right>
<Enter>
<Del>
<F2>@<F2>
<Backspace>
<F7>
<Shift-F3>
<Alt-F10>FOOTREP<CR>
<Ctrl-F10>
```

Begin macro definition
Call it FOOTEDIT
Switch to Doc 2
To top of document
Enter a blank line
Switch back to Doc 1
To top of document
Call the macro FOOT
End macro definition

Begin macro definition
Call it FOOT
Edit the next footnote
Block on after footnote number
To bottom of footnote
Delete it
Switch to Doc 2
Restore the deleted text
Insert a @ and a carriage return
Switch back to Doc 1
Exit footnote editing
Call FOOT again
End macro definition

Begin macro definition
Call it FOOTNEW
To top of file
Switch to doc 1
To top of file
Switch back to doc 2
Invoke macro FOOTREP
End macro definition

Begin macro definition
Call it FOOTREP
Block on
Search for the next @
Copy the block
Switch to Doc 1
Edit the next footnote
Move past the footnote number
Put the copied block here
Delete the extra space
Find the @ ...
and delete it
Exit footnote editing
Switch back to Doc 2
Call FOOTREP again
End macro definition

Figure 1: The four WordPerfect 5.0 macros above let you bring all your footnotes together into document 2, edit them for stylistic consistency, and then return them to your original document. These macros also let you print your footnotes as a unit so you can check them.

feature to good use.

I find it hard to remember the names of macros that I seldom use. To deal with this problem, I use the so-called "temporary" macro to call up a listing of macro files. My macro is simple enough to use, though it assumes that Shift-F1 (Setup) has been used to specify a directory for all macro files. If you have files stored in more than one data directory and you use different

macros in each, your macro must be slightly different.

When you choose to use a single directory for storing all macros, you can use the following macro, substituting your own directory name:

```
{List Files}c:\wp\*.wpm[Enter]
```

If you store macros in different directo-



Power User

ries, the following will list the macros in your current directory:

```
[List Files][End][Backspace]wp[Enter]
```

WordPerfect, Version 5.0, gives you the option of saving a description of a macro when you create or modify it. When you are viewing the list of macros in a directory, the (Look) command will show these same macro descriptions.

If you want to edit the "temporary" macro, you'll have to press Ctrl-F10 (Macro Def) and specify WP(WP).WPM as the macro name. WordPerfect 5.0 normally lets you use its built-in macro editor if the macro name you specify is already defined. The "temporary" macro requires this special treatment, however, for if you just press Enter, the old "temporary" macro will be replaced.

Lonnie Supnick
Kalamazoo, Michigan



I always use the "temporary" macro for one-shot macros—those that won't be needed again. For example, I would use a temporary macro for a looping macro that fixes some oddity of one particular input file. The alternative is to use up an Alt-key or invent a name such as GETRID.WPM to remind myself to delete the macro after I have finished using it.

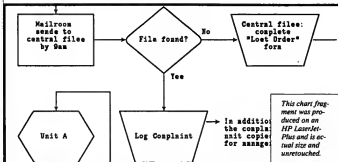
Thus, I wouldn't use the temporary macro for a macro file listing. Instead, I'd call the macro LISTMAC or HELP—something that would be easy to remember. And I would store it in the same directory as the WordPerfect files so that it would always be available. Leave the temporary macro for temporary purposes.—Neil J. Rubenking

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Tutor

CHOOSING THE RIGHT BUFFERS VALUE

I recently acquired two software packages, a public-domain package called *Thrasher* and a commercial package called *Helpme*. *Thrasher*'s sole purpose is to determine the optimum number of buffers to use in CONFIG.SYS for maximum system efficiency. Part of *Helpme* is meant to accomplish the same thing.

After using both packages, I'm stumped. *Thrasher* ran for hours and then stipulated 12 buffers. *Helpme* ran for about 10 seconds and recommended 35. Why the difference in run times, and which value is correct?

Vincent Lozupone
Nashua, New Hampshire

PC The programs you've encountered take drastically different approaches to recommending how much RAM you should dedicate to DOS's simple disk cache.

Helpme mathematically estimates the number of 512-byte buffers you should specify based purely on disk statistics, such as the number of files on the disk and their level of fragmentation. *Thrasher*, on the other hand, takes a brute-force approach. You specify a range of buffers values you'd like it to test, and it carries out extensive disk exercises for each value, automatically changing the buffers value in the CONFIG.SYS file for each trial and writing the test results to an ASCII report file.

With that said and done, the bottom line is that it probably doesn't matter too much which value you use as long as you stay away from the extremes. There is no one right value. To illustrate my point, I ran *Thrasher* on the hard disk of my Compaq Deskpro 386/20, trying values all the way from 1 to the maximum of 99. The results for the first ten values (1-10) are listed in Figure 1.

Test results for the remainder of the buffers values bounced between 22 and 24, leaning more toward the 24 at the up-

■ **CHOOSING THE RIGHT BUFFERS VALUE:** Two very different approaches to determining the optimum number of buffers.

■ **WEITEK'S NUMBER-CRUNCHING 3167:** The 3167's advantages over Intel's 80387.

■ **A BRAIN-DAMAGED MICROPROCESSOR?** The 286 is unable to switch from protected mode back to real mode without a hardware reset.

per end of the 99-value buffers range.

Of course, not all systems will behave exactly like my Deskpro. For starters, the Deskpro's extremely fast memory keeps an overly large number of buffers from being a problem. On slower machines, a buffers value larger than 60 or so might actually slow down performance, since DOS will have to plow through 30K or so of memory before each disk access, negating the time savings of the small disk cache in the long run.

The point, though, is that as long as your buffer is big enough to catch a fair number of cache hits—use 15 to play it safe—the performance difference between even a value of 15 and 40 will be slight, at best. You're better off keeping your buffers value fairly low simply to conserve RAM, as long as none of your applications require a higher value (some do).

A discussion of the buffers command wouldn't be complete without a strong recommendation that you attack the problem of disk performance with a bigger stick—a full-featured disk cache.

Nearly any disk cache you can get your hands on will give you a considerable per-

formance gain over DOS's buffer. If you like your software free, try DCACHE, a PC Magazine program you can download from PC MagNet. If you'd rather have a slick commercial package, take a look at the February 14, 1989, issue of PC Magazine, in which we reviewed 13 low-cost disk-caching utilities ("Getting the Most Out of Memory"). *Super PC-Kwik*, which won Editor's Choice for its speed and wide range of options, allows you to run large caches in expanded or extended memory while occupying little of your precious 640K.—Mitt Jones

WEITEK'S NUMBER-CRUNCHING 3167

Evaluating 80386-based machines for purchase, I keep running across references to the Weitek 3167 coprocessor. As I understand it, the Weitek chip runs programs three to five times faster than its 80387 counterpart. Why is it so much faster than the 80387?

More important, for what kind of applications will the Weitek's performance justify its greater cost? Can it coexist with an 80387? Will the Weitek chip run programs written for the 80387?

Nicholas L. Feakins
San Mateo, California

THRASHER TEST RESULTS

BUFFERS Value	Thrasher Test (seconds)
1	180
2	157
3	154
4	145
5	73
6	41
7	24
8	23
9	22
10	22

Figure 1: With 1-10 specified as the range of buffers values, *Thrasher* tested each value and gave the results listed above.

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Three to five times as fast is probably a bit optimistic, but even the more realistic gain of two to three times as fast means serious performance improvement.

The Weitek gets its superior speed from its design as a memory-mapped coprocessor, meaning that it appears to the CPU as a large block of physical memory (from C0000000h to C000FFFFh). This design gives it two primary benefits over the conventional design of the 80387. First, whereas the 80387 uses only the PC's data bus to send and receive operands and operation codes, the Weitek uses both the data bus and address bus, reducing the number of processor cycles needed to transfer instructions. Second, it maintains dedicated 64-bit floating-point multiplier and arithmetic logic unit data paths, again allowing a greater bandwidth than the 80387.

These performance gains will be drastic on nearly any package that makes heavy use of floating-point math or mathematical functions. Obvious examples are CADD programs such as *VersaCAD*, mathematics packages such as *Mathematica*, and nearly any engineering design package you can think of. If you frequently find yourself dealing with mammoth spreadsheets, you'll also want to consider adding a math coprocessor. The Weitek is weakest when dealing with transcendental functions, such as trigonometric and logarithmic functions. Even on these, however, it surpasses the performance of the 80387 by a significant margin.

As I mentioned earlier, the Weitek is much different from the Intel. Thus, it requires software support different from Intel 80387 support. All the applications I've mentioned above support the Weitek, and the list is growing fast, but the Intel has gained wider support thus far. You should ensure that your applications support the Weitek (call the software maker for the most up-to-date word) before you plunk down your money.

Fortunately, if you need the speed of the Weitek but don't want to give up the wider support for the 80387, you can have both. The Weitek 3167 is a single-chip version of Weitek's original, three-chip 1167. In addition to a few other benefits of the single-chip design, the 3167 can plug into the relatively new Extended Math Coprocessor (EMC) standard socket, which

is designed to accept either the 80387 or Weitek 3167. If your machine of choice has two EMC sockets, you'll be able to install the 80387 and the 3167. While you'll have no problem running one and then the other, you'll be able to make use of only one at any given time. —Mitt Jones

A BRAIN-DAMAGED MICROPROCESSOR?

For years I've been hearing about how the 286 is a brain-damaged microprocessor. And for years I've seen nothing but phenomenal success for it. How can the two go together like that?

Can you explain how the DOS Compatibility Box works under OS/2? I've read that when DOS is running, everything else goes to sleep. Surely this isn't real multitasking. As near as I can tell, this is due to the 286 being a brain-damaged microprocessor. Any enlightenment would be appreciated.

Steve Wolf

Pittsburgh, Pennsylvania



The success of the 286 can mostly be attributed to its ability to run software a good deal faster than an 8086 or 8088. It's that simple. As to the chip itself being "brain-damaged," well, that is perhaps an unfortunate term that came about for one specific reason.

The 286 chip is able to run in one of two different modes—real or protected addressing mode. In real address mode the chip is limited to behaving exactly like an 8086/88—but a very fast 8086/88. In protected mode the chip is able to provide the kind of memory management and virtual memory support necessary for a multitasking operating system such as OS/2. It's called protected mode because each executing task's memory space is "protected" from being overwritten or accessed by any other task. When the 286 is in real mode it is limited to a 1MB address space—again, the same as the 8086/88. In protected mode the system can access up to 16MB of memory.

Clearly, protected mode is a much more desirable environment than real mode. This was so clear to the 286 architects at Intel that they reasoned that once the 286 was in protected mode there would be no reason ever to go back to real mode, which is actually not such a terrible assumption to have made. Intel also reasonably supposed that it might be desirable in some cases to be able to duplicate the 8086/88 environment, so the company built a real mode into the chip. In fact, the

Tutor

way it was supposed to work, the 286 would initially boot up in real mode, in essence the 8086/88 environment. Getting to protected mode was simply a matter of executing a certain instruction. But, and this turns out to be a very big *but*, Intel never supplied the means to go from protected mode "back" to real mode.

When IBM and Microsoft began working on OS/2 there had been talk of building it directly to the new, 32-bit 386 chip, which had the ability to emulate the 8086. But there was no emulation support for the 286. Because the 286 (AT-class machines, in other words) had gained such popularity, IBM decided the new operating system had to run on the 286 chip. This meant that it would be able to take advantage of neither the 386's 32-bit design nor its ability to emulate the 8086. Building a multitask-

mode. This is surely a kludge if ever there was one. Nevertheless, Microsoft and IBM managed to make it work.

OS/2, therefore, supports the DOS environment by actually placing the 286 in real address mode. The method is clever, but there are trade-offs. When the chip is in real mode it no longer has the benefits of protected mode. Every DOS limitation including the 640K memory limit exists. The benefit is that DOS programs that change segment register values can still do so. This capability is crucial to many DOS applications. OS/2 simulates (or emulates) most of the BIOS and DOS services available under DOS itself.

There is one thing Steve Wolf has backwords in his question. When the DOS session is in the foreground, OS/2 still allows protected-mode applications to execute. It continues to switch between real and protected mode, giving OS/2-based applications the necessary time slices to run. However, if you start up a DOS application in the DOS session, then switch to an OS/2 application (putting the DOS session in the background), the DOS application will be frozen until it is once again brought to the foreground. The bottom line is that you cannot multitask an application running in the DOS session when the DOS session is in the background.

This situation exists because there is no way for the 286 to trap ill-behaved DOS programs when they try to directly access hardware such as the video registers. DOS programs are therefore allowed to run only when they have access to the actual physical console (that is, when they are in the foreground), which they do not have access to when they are in the background.

The bottom line is that the reality and economics of the marketplace caused IBM to use the 286 chip in a way that its original designers didn't plan on. Is the chip brain-damaged then? It's really your own call . . . you decide.—Tony Rizzo

ASK THE TUTOR

The Tutor solves practical problems, explains points of general interest about using your hardware and software more productively, and answers basic questions about DOS and systems in general. To see your questions answered here, drop a line to Tutor, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload them to PC MagNet (to join, see the "By Modem" sidebar in the Utilities column). We're sorry, but we cannot answer questions personally. ■

Clearly, protected mode is a much more desirable environment than real mode.

ing operating system on the 286 wasn't of itself a problem. But unfortunately the new operating system also had to support DOS, for obvious reasons.

The problem was that for the operating system to support both DOS and a multitasking environment, the hardware would have to switch back and forth between real and protected mode. Imagine what the designers of OS/2 felt when they had to provide this environment on a chip that "couldn't" go back to real mode once it was switched into protected mode. This was major cause for exasperation, leading to the 286 being perhaps unfairly dubbed a brain-damaged chip.

We can't go into this in more detail, but remember that the 286 initially starts itself up in real mode. So, the OS/2 designers (specifically Gordon Letwin) reasoned, if they could cause a hardware "reset" of the chip, they could actually switch it back to real mode. And of course, once in real mode it was easy to get back to protected



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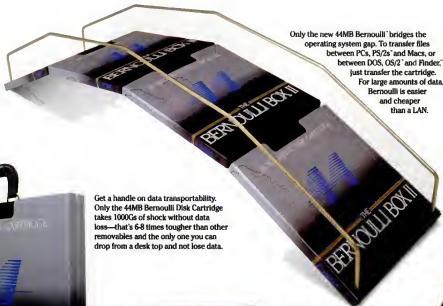
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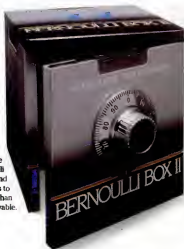
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CIRCLE 312 ON READER SERVICE CARD

by
Frank J. Derfler, Jr.

Connectivity Clinic

AT TO VAX CONNECTIONS

Our firm has purchased a VAX 11/780 to run a large inventory package which I'll need to access. This necessitates my having access to a terminal. What software or hardware do I need to use my IBM AT as a terminal connected to the VAX?

Jay Warring
Bayonne, New Jersey



First you'll need a serial card for the AT if you don't already have one. Look at the back of your machine. The card you are looking for has two connectors—a 9-pin male (serial port) which is directly above the 25-pin female (printer port). In addition, you will need terminal-emulation software which will make your IBM PC imitate DEC terminals such as the VT102 or VT220. Typical emulation packages are Persoft's *SmartTerm* and Walker Richer and Quinn's *Reflection* series. Other general-purpose communications packages such as DCA's *Crosstalk* also include good terminal emulators.

SELECTING AN E-MAIL SYSTEM

I'm looking for a good electronic mail system for our Novell LAN. We want to send and receive messages among 24 network users with a minimum of fuss. Some of the staff have used Wang and DEC mail systems, and they stress that we need mailing lists and an easy way to reply to messages. What do you suggest?

Tom Curran
Harrison, New York



In many installations, e-mail is just a function that is part of some larger office system. The leading office productivity packages, such as *WordPerfect Office*, *Data Access's Office Works*, and *Higgins* from Conetic Systems, are all based on e-mail. These companies market their products by pushing features designed to increase workgroup productivity, such as meeting scheduling, central database management, and others. But the programs each depend upon e-mail

■ AT TO VAX CONNECTIONS:

A terminal emulator and a serial card are all you need to connect an AT to a VAX.

■ SELECTING AN E-MAIL SYSTEM:

There are many good e-mail systems from which to choose—bundled or alone.

■ ACCESS TWO NETWORKS SIMULTANEOUSLY:

How to log in to NetWare and StarLAN at the same time.

■ CONNECTIVITY UPDATE:

How to get back up to speed on connectivity issues.

■ LOW-COST LANs:

There are many connectivity alternatives even for a limited budget.

to get the work done.

My favorite product in this category is easy to use and very effective. It's called *Right Hand Man*, and it includes group and resource scheduling, shared telephone files, calculators, and even a nice windowing feature. The heart of the program is an electronic mail system that we have successfully used with dozens of LANs and multiuser operating systems. The *Right Hand Man* program is marketed by Future-

Soft ((800) 327-8296). The 10-user version retails for \$899, and the 25-user version sells for \$1,875.

If all you want is pure and feature-rich electronic mail, then there are three products to consider. *The Network Courier* from Consumers Software ((604) 688-4548), *cc:Mail* from cc:Mail ((415) 321-0430), and a newcomer called *Da Vinci e-Mail* from Da Vinci Systems ((919) 839-2000). These products play a constant game of "I've got more features than you do!" with each other, but the end user is the winner of this competition. My favorite changes with each demonstration of each new revision—they are all good.

ACCESS TWO NETWORKS SIMULTANEOUSLY

Our network has AT&T 386s with 68MB hard disks, each partitioned into three drives. Drives C: and D: are each 32MB and E: is 4MB. We use *SFT NetWare I*, Version 2.0a, and the hardware in each PC is an ARCnet PC110 board. A Compaq Deskpro 386 is the file server. After the LAN was up and running, we decided that we would also like to use our PCs as UNIX terminals to an AT&T 3B2-500 minicomputer.

We chose to make the PCs part of two LANs by linking the Novell LAN to the 3B2 with *StarLAN* (software and boards) and terminal emulation. However, before we could install *StarLAN*, the IRQ interrupt jumpers and the RAM memory address jumpers had to be different on each board (as well as different from the settings on any graphics boards or other boards installed in the PC). This was necessary so that the *StarLAN* and ARCnet boards could coexist.

After installing *StarLAN*, we were dismayed but not very surprised that we could no longer log on to the Novell network. Version 2.0 does alter the AUTOEXEC.BAT and CONFIG.SYS files of a PC on the network. The Novell "workstation shell" had enabled us to link to the Novell file server as drive F:; but *StarLAN* made it impossible to recognize drive F: even with the Novell shell loaded. We could log into *StarLAN*

Connectivity Clinic

by loading the StarLAN "client shell" and linking to a drive (we chose G:, since A: through F: already had specific functions). This drive is the home directory on the AT&T 3B2 file server.

After some tinkering, we found that the StarLAN installation added the line LASTDRIVE=N to CONFIG.SYS. By removing this line we could once again link to F: and log in to the Novell network, but StarLAN couldn't link to G: or any drive above G.: it seemed as if there was no way to have the LANs coexist short of rebooting with a different CONFIG.SYS each time we went between networks.

Finally, we discovered that by leaving out LASTDRIVE=N from CONFIG.SYS and by linking to StarLAN through drive E:, we still were able to link to the Novell network through drive F:. Not only could we link to both networks, but it was also possible to log in to both at the same time. The PCs recognized drive E: because the hard disks were partitioned as C:, D:, and E: upon setup. From a PC logged in to both

networks it's possible to copy files from one server to another and to print a file on one server using the printer attached to the other server.

This solution is not terribly efficient, because the local drive E: is not accessible while linked to StarLAN. And even though drive E: is pretty small (only 4MB), it's still "wasted." On the other hand, it works!

Max Moritz
Long Beach, California



First, congratulations on getting the ARCnet and StarLAN cards to coexist in the workstations. That took judicious planning. I gather that you bought a StarLAN board for each client station. You could have saved yourself a little hassle by buying Ethernet boards, replacing ARCnet with Ethernet, and linking to the 3B2 with Ethernet. Ethernet cards from Gateway will reuse the ARCnet RG-62 coaxial cable (other Ethernet cards will not).

We haven't tried this at PC Labs, but here's an idea to regain the use of the 4MB partitions on your local drives. First, make the smallest RAMdisk possible through a device driver installed in CONFIG.SYS.

This RAMdisk will become F:, the next logical drive. NetWare will take drive G:. This will let you map F: to StarLAN and regain E:. You will lose some RAM to an unavailable virtual disk, but you will regain 4MB on your hard disk.

CONNECTIVITY UPDATE

I enjoy the information included in Connectivity Clinic every issue. I have been out of the country and need to get back up to date. Does PC Magazine publish this information in any other form or must I buy all possible back issues? Can you recommend other publications that concentrate on telecommunications and connectivity issues?

Mark Nicholson
Glendale, Arizona



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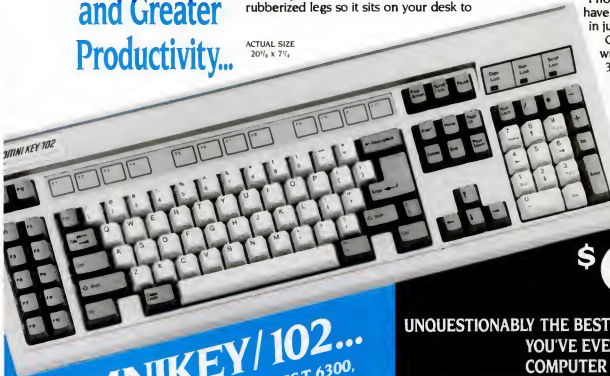
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—Sally & Daniel Grotta
The Robb Report, Feb. 1989

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Connectivity Clinic

Week, has a Connectivity section that focuses primarily on news items.

LOW-COST LANs

I have to come up with an economical LAN system consisting of a Compaq Deskpro (XT clone) and one dumb terminal. The Deskpro has a 30MB hard disk, 640K memory, and is connected to a high-speed dot matrix printer. It must also act as an input device. Only two users will be using the system. Because of budget constraints, I can only afford to add the terminal and associated LAN software and hardware.

What software and hardware would you suggest to keep the price of such a system below \$2,000?

Orrie H. Smith
Midland Park, New Jersey



There are several economical and practical ways to share a single machine through a dumb terminal. Using a Deskpro with a less-powerful processor than many that are available today

does limit your choices, however.

If you confine yourself to using a dumb terminal, you are eliminating a class of products I call Zero-Slot LANs (ZSL). These products run programs on two PCs connected together through their serial ports. Typically, this architecture is effective for file exchanges and printer sharing. If this is all you want to do, then you should consider buying a very low-cost PC to give you flexibility and use the ZSL programs from Server Technology or Traveling Software.

If your host machine contained an 80286 or 80386 processor, you could take advantage of one of several multi-user operating systems or DOS add-on packages now available. PC-MOS, Concurrent DOS, VM-386, and other packages offer low-cost multiuser operation using an inexpensive serial port on the host. This is the lowest-cost alternative, if you have the processor to support it.

But I don't think you want to time-slice that limited processor. So another option you should strongly consider is a clustered-CPU slave card. Alloy makes a relatively low-cost slave card with a serial connection for your dumb terminal. Their

software allows high-speed sharing of the hard disk on the host and will provide better service for database and similar applications.

And finally, for your allotted \$2,000 budget, you could buy an expensive PC and still find \$200 per node to load in a full LAN system such as *LANtastic Network Operating System*. That alternative will give you the most flexibility and growth for your money.

NETWORK YOUR QUESTIONS

Connectivity Clinic gives you practical solutions to networking problems of all types. We'll pay \$50 or more for any tips we print, *plus an extra \$25 if you submit your letter on-disk*. If you do, please include a printed copy. We'll gladly answer your questions at no charge, but we cannot answer letters personally. Mail contributions to Connectivity Clinic, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload them to PC MagNet (to join, see the "By Modem" sidebar in the Utilities column). You may also contact Frank J. Derfler, Jr., via MCI Mail (use Derfler's box named CONNECTIVITY CLINIC).

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OS/2 NEWS

Volume 1, No. 4.

A continuing report on advanced software for personal computers.

Sophisticated reminder system helps you automate your processing tasks.

Envynt Development Corporation has started distributing *Tickler/2™*. This advanced automated reminder system lets the user create a series of reminders to occur before, during and/or after an event. *Tickler/2* can even remind your computer when to perform certain tasks. Because it can be used in conjunction with your data base, spreadsheet, E-mail and project management software, it gives you amazing versatility. For example, you could set up *Tickler/2* to take a previously generated sales forecast spreadsheet, update it daily, print a report and electronically mail it to another computer at the end of every week...all while you're on vacation. For more information on the advanced capabilities of *Tickler/2* call 1 303 286-8686.

PC Paintbrush now available for Presentation Manager.

The OS/2™ version of PC Paintbrush® uses Presentation Manager™ to make creative expression fun, fast and easy. PC Paintbrush for OS/2 is a graphics creation package that includes all the features of the DOS-based version. It lets you create intricate free-hand graphics using the various brushes, lines, curves, colors and patterns. You can also use scores of drawing and text tools to create presentation-quality documents. For more information call ZSoft at 1 404 428-0008.



Word processing that goes beyond just words is introduced for OS/2.

DisplayWrite 5/2 Composer™ has been released by IBM. This advanced word processing software lets you scan photos and line art into your document, position them anywhere on the page, even make text flow around them...all without cutting or pasting. DisplayWrite 5/2 Composer capitalizes on the protected mode and multitasking capabilities of the IBM OS/2 environment so you can run it as a foreground or background operation. See your IBM Authorized Dealer or IBM marketing representative for complete information.

New relational data base system helps PC users handle large volumes of data.

R:BASE® is an easy-to-use OS/2 relational data base management system that features both menu and command-line interfaces. And because it includes LAN support for up to three simultaneous users using the multitasking and networking support enhancements of OS/2, it's cost-effective as well. R:BASE also provides programming language support, and over 70 business and scientific functions are already integrated into the program. For more information on how R:BASE can help you manage large volumes of data call MICRODIM at 1 800 624-0610.

Symantec's Q&A provides powerful file management for OS/2.

Q&A™ is an integrated flat-file data base and word processor that offers OS/2 users a unique combination of power and simplicity. With Q&A you can take advantage of OS/2 benefits like multitasking and large memory. Q&A OS/2 also offers the ability to share data bases on a network with the DOS version of Q&A. Multifile lookup in Q&A means you can merge data from multiple Q&A data bases into customer-designed forms and reports. Q&As executive word processor lets you create presentation-quality documents and easily perform mail merge with your data. For more information on how Q&A can solve your data base and word processing needs call 1 408 253-9600.



OS/2-based Platinum provides true multitasking accounting packages.

The Platinum® Series of fifteen accounting modules from Advanced Business Microsystems is a business accounting tool so powerful that on a single computer you can print and post several hundred invoices and checks, run a reconciliation, generate consolidated financial statements—and enter new budget figures at the same time. Platinum also makes it easy for you to integrate your accounting data with data bases, spreadsheets, presentation graphics, word processing, desktop publishing and other applications. For more information on Platinum call 1 800 999-1809.

Free OS/2 Application Guide available.

You can receive a 340-page OS/2 Application Guide that lists and describes over 800 identified applications for the OS/2 operating system. For a free copy of this guide call 1 800 IBM-2468, ext. 120.

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INTEL

80287/8/10 225/245
80387-16/20/25 375/475/595

PRINTERS

DICONIX 150 Par w/3" cable 279
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Leather Case by Toshiba: Specify for
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Megahertz 1200/2400 169/229
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8 BIT PC/XT	\$299	\$219	\$479	\$599	
16 BIT PC/AT	N/A	\$279	\$549	\$639	
MDM PERFORMANCE	21MB 40MB	32MB 40MB	40MB 40MB	40MB 40MB	65MB 160MB
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See



TakeTwo
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For ST200 Conversion SCSI Hard/ floppy Controller add \$40



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Tandy 1000
kits add \$20

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Turbo/10 System	MGA	EGA	VGA
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30MB	\$849	\$1,299	\$1,419

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- Six 16-bit and two 8-bit expansion slots
- 80287 math coprocessor support
- Choice of enhanced 101-key, AT-style, or 5151 keyboard
- 9.4 on Norton's SI 4.0 test



\$895

286/10 System	MGA	EGA	VGA
30MB	\$1,249	\$1,599	\$1,715
60MB	\$1,449	\$1,799	\$1,915

CompuAdd 286/12

- 80286 processor running at 12MHz or 6MHz switchable system speeds
- 0 wait state
- 512KB RAM expandable to 1MB
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- Dual diskette/hard drive controller
- Six 16-bit and two 8-bit expansion slots
- 80287 math coprocessor support
- Choice of enhanced 101-key, AT-style, or 5151 keyboard
- 13.7 on Norton's SI 4.0 test

\$945

286/12 System	MGA	EGA	VGA
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40MB	\$1,499	\$1,849	\$1,969

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- Six 16-bit and two 8-bit expansion slots
- 80287 math coprocessor support
- Enhanced 101-key keyboard

\$1495

286/16 System	MGA	EGA	VGA
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- Dual diskette/hard drive controller
- Integrated Drive Electronics (IDE) fixed disk drive interface (on 20MHz and 25MHz systems)
- Two serial ports and a parallel port built-in
- Enhanced 101-key keyboard



CompuAdd 286/20

- 80286 processor running at 20MHz or 8MHz switchable system speeds
- 0 wait state (four-way interleave)
- 1MB RAM expandable to 5MB
- ROM-based setup
- Six 16-bit and two 8-bit expansion slots
- 80287 math coprocessor support
- 20.4 on Norton's SI 4.0 test (22.5 rating with 2MB memory and four-way interleave)

\$1595

286/20 System	MGA	EGA	VGA
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80MB	\$2,345	\$2,695	\$2,815

CompuAdd 386/16

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- 1MB RAM expandable to 4MB
- Five 16-bit and two 8-bit expansion slots
- 80287 math coprocessor support
- Choice of enhanced 101-key, AT-style, or 5151 keyboard
- 17.6 on Norton's SI 4.0 test

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386/16 System	MGA	EGA	VGA
40MB	\$2,355	\$2,705	\$2,825
80MB	\$2,545	\$2,895	\$3,015

CompuAdd 386/20

- 80386 processor running at 20MHz or 8MHz, software-selectable system speeds
- 0 wait state (32KB cache memory)
- 32-bit high speed RAM board with 1MB RAM expands to 16MB
- System and option ROM shadowing
- ROM-based setup
- Six 16-bit and two 8-bit expansion slots
- Math coprocessor support for 80387 or Weitek
- 23.0 on Norton's SI 4.0 test

\$2195

386/20 System	MGA	EGA	VGA
40MB	\$2,755	\$3,105	\$3,255
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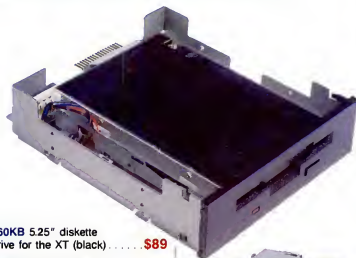


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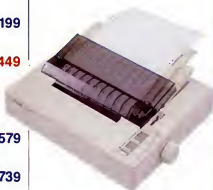
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CPU	8088-2	8088-1	V20	80286	80286	80386	80386
Speed (Mhz)	8.4/77	10.4/77	12.4/77	12.5/8	16.8/8	20.0/8	24.8/8
BIOS	ER50	ER50	ER50	AMI	AMI	AMI	AMI
Wait States	1	0/1	0/1	0/1	0/1	0/1	0/1
Standard Memory Config.	640K	640K	640K	1MB	1MB	1MB	1MB
On Board Memory Expansion				4MB	8MB	8MB	8MB
Shadow RAM BIOS				384K	384K	384K	384K
Coprocessor Support	8087	8087	8087	80287	80287	80387	80387
Expansion Slots	8-6 bit	8-6 bit	8-6 bit	2-8.5-16	2-8.5-16	2-8.5-16	2-8.5-16
Dual Hard Floppy Controller	w/H D	w/H D	w/H D	Yes	Yes	Yes	Yes
Device Bay(s) External/Int.	4-E	2-E, 2-I	2-E, 2-I	3-E, 2-I	3-E, 2-I	3-E, 2-I	3-E, 2-I
Serial Ports	1	1	1	optional	optional	optional	optional
Parallel Ports	2	2	2	1	1	1	1
Game Ports	2	2	2	1	1	1	1
Bus Mouse Port	1	1	1	1	1	1	1
Power Supply Size	150W	150W	150W	200W	200W	200W	200W
Key Tronics USA Keyboard	Yes	Yes	Yes	Yes	Yes	Yes	Yes
ED-DOS 4.0 w/EMM, topDOS	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Battery Backup Clock	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Normal SI Rating 4 Division	1.8	2.1	4.9	14	16.3	22	26
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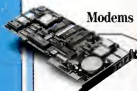
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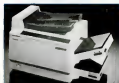
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HS3000 Pictured

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OC1478 Pictured

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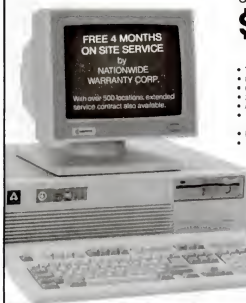
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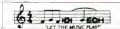
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■ 16-BIT HIGH-RESOLUTION VGA CARDS

The new software—particularly graphical interfaces, desktop publishing programs, and presentation graphics applications—demands superior video display. PC Labs evaluates 15 graphics cards capable of 800 by 600 Super VGA resolution.

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It's *SuperCalc!* Able to leap tall *Lotus 1-2-3* spreadsheets, and with impressive graphing ability to challenge *Microsoft Excel*, this new release raises the ante in the PC spreadsheet market.

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PC LAN Labs examines the latest in peripheral-sharing equipment. No longer the simple black box that allowed two PCs to share a printer, these 14 data switches can handle up to eight workstations, at significant savings.

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After Hours

Products for the Leisure Side of Personal Computing

Jet Fighter Simulators: State of the Deadly Art

GAMES
by John C. Dvorak

Flight simulators are one of the great programming challenges. Over the years the dominant product has been the simple *Flight Simulator* from Microsoft. Its popularity set the stage for a slew of simulators ranging in quality from mediocre to very good.

The hottest new entrants into the fray are *F-19 Stealth Fighter* from MicroProse Simulation Software and *Jetfighter* from Velocity (distributed by Broder-

bund Software). When compared with *Jetfighter*—which uses the EGA color graphics set—*F-19's* visual effects pale. In fact, as far as nifty details and action are concerned, *Jetfighter* is the best simulator I've seen on a desktop computer, period. It's also the most fun.

I think this is because *Jetfighter's* smooth cartoon-like animation borders on the fantastic. These guys take the EGA to the extreme with incredible animation and simulations of everything from explosions to fires.



Both jet simulators offer a variety of external views, but *Jetfighter* has a wider choice of viewing perspectives.

bund Software). I can recommend both games but prefer *Jetfighter* in a side-by-side comparison.

F-19 can utilize the VGA display and produce some stunning visual images. The cockpit, in particular, is much prettier in *F-19* than it is in almost any other simulator. Unfortunately, that's about where it ends. Except for the opening screens and the cockpit, the graphics fall off rapidly. The details outside the cockpit are not maximized for

The visual killer, though, for *Jetfighter* is the ability to not only do an external view from outside the plane but also to pan up, around, down, underneath, in front of, and behind the plane while zooming in and out—all in real time. Just seeing this is worth the price of the game. Every time I play this game I'm impressed with its special effects.

I tested *Falcon*, *F-19*, and *Jetfighter* on the 11-year-olds in the neighborhood, and *Jet-*

fighter was the winner with them, too. *Jetfighter* allows you to fly an F-14, an F-16, or an A-4. Kids love the F-14 because they remember it from the movie *Top Gun*, so there is a built-in bias. *F-19*, on the other hand, offers us only a nonexistent stealth fighter.

ANNOYING INTERFACE

For me, the big problem with *F-19* is its interface. For one thing, it uses three layers of copy protection. Annoying is the operative word. First of all, it requires a key disk. Second, it requires you to have the manual to identify an outline of an enemy jet that is put onto the screen. This changes each time, and it's basically a pain to figure out the plane (I misguessed more than once). Finally, it is nearly impossible to operate the game without a very large template that goes over the entire keyboard.

No mnemonics are used, so you spend much of the time fumbling around trying to find the various commands until you memorize the most important ones. With *Jetfighter*, you can figure out most commands me-

GAMES:

- John C. Dvorak looks at two of the newest jet simulators.
- Grand Prix Circuit: Safety belts required.
- Destiny Knight, The Bard's Tale II: A role-playing game to get lost in.
- Pete Rose Pennant Fever: Batter up!

monically (B is for breaks, G is for gear, and so forth).

Also, *Jetfighter* installs and deinstalls from a hard disk and requires no key disk when installed. Its single layer of copy protection works fine and doesn't interfere with the game

CONTINUES



F-19 Stealth Fighter has a very detailed view of the jet's cockpit. The game offers a wide selection of weaponry.



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continued

After Hours

CONTINUED

as does the irksome and paranoid approach of MicroProse. This aspect alone is enough to make me chose *Jeftighter* over *F-19* if I had to pick just one.

F-19's strengths lie in its overall versatility. You have a large collection of weaponry from which to choose for each mission, and this definitely makes some of the missions more interesting. Unfortunately, the emphasis on versatility is negated somewhat by lack of detail insofar as missile firing and bomb dropping is concerned. For example, take chaff (please!). When you drop chaff from an *F-19* the screen tells you that you dropped chaff. Even from the exterior view, you see nothing happen. With *Jeftighter* you actually get to see the chaff released.

BOMB THE BANK

The different levels of detail outside the jet aren't limited to the chaff. Missiles, bullets, and scenery are more interesting in *Jeftighter*. Anyone from San Francisco will be particularly fond of an ability to bomb the Bank of America and strafe the Golden Gate Bridge.

Both these programs are better if used on an AT-class or faster machine. One flaw in *Jeftighter* was the lack of a "boss" key to turn off the game for a

moment if one wants to cover up the fact that the game is being played. This is no oversight. Apparently the programming team arrogantly refused to put a boss key into the game because people should not be playing games on company time. Hey, boys: mind your own business.

I use a boss key to keep the younger family members from hording in a game when I'm reviewing. *F-19's* boss key was incompatible with my Compaq VGA display, but it's supposed to put a DOS prompt on the screen.

The fact is you can't go wrong with either game, but the multiple layers of copy protection on *F-19* ruin the game for me. Get *Jeftighter* and save \$20 and the aggravation.

List Price: *Jeftighter*, \$49.95. **Requires:** 512K RAM, EGA or VGA graphics adapter, DOS 2.0 or later. 80286 or 80386 processor recommended. Copy protected but hard-disk installable. Velocity Development, Box 875, Palatine, IL 60078; (312) 991-0594.

CIRCLE 421 ON READER SERVICE CARD



Jeftighter offers excellent animated graphics of a variety of in-flight situations.



The road course simulations in *Grand Prix Circuit* were prepared from actual track blueprints.

List Price: *F-19 Stealth Fighter*, \$69.95. **Requires:** 384K RAM, graphics adapter, DOS 2.1 or later. Copy protected through key disk. MicroProse Simulation Software, 180 Lakelands Dr., Hunt Valley, MD 21030; (301) 771-1151.

CIRCLE 422 ON READER SERVICE CARD

Grand Prix Circuit: Thrills for Would-Be Mario Andrettis

GAMES
by Don Trivette

Driving a Ferrari V12 at 150 mph can have an adverse effect on your automobile insurance rates, unless you are driving on Accolade's *Grand Prix Circuit*. Turn for turn and straightaway for straightaway, actual race-track blueprints were used to design *Grand Prix's* re-creations of the world's great race courses.

Playing *Grand Prix Circuit*, you can try your nerve at Hockenheim-Ring in Germany or at any of the seven other Formula One championship road courses.

This latest simulation from the folks who brought us *Test Drive* has enough options to keep Mario Andretti entertained. First, you pick whether you want to practice, race on a

single track, or test your nerve against the eight courses in the World Driving Championship Circuit.

Three muscular Formula One cars wait in your garage: a Ferrari V12 (good handling, stable, a car for beginners), a six-speed Williams with a V8 Renault engine (average speed, handling, and braking), and a

McLaren that's powered by a Honda Turbo (super fast, but easily lost on turns). Each racer simulates the performance characteristics of the real cars at speeds up to 200 mph.

There are five skill levels, but you are well advised to start as a beginner so you don't have to worry about shifting gears or blowing an engine. Mercifully, your fellow drivers treat you like a grandmother out on a Sunday spin. At level three you begin real driving. You must shift, watch for spin outs, and keep an eye on the other cars.

The pros square off at level five. In this fast company, your engine is easily damaged. Many additional details require your attention. You must watch your gauges, and pit stops are a fact of life.

Grand Prix Circuit, like *Test Drive*, presents you with a spectacular view of the instrument panel, the course, and the surrounding scenery. The EGA graphics are outstanding. But in this simulation there are no cops to outrun and no cliffs to side-swipe. The challenge is to keep four wheels on the track and dust in the other guy's face.

List Price: *Grand Prix Circuit*, \$39.95. **Requires:** 384K RAM for MGA or CGA graphics, 512K for EGA or Tandy 16 color graphics; graphics adapter; DOS 2.1 or later. Key disk copy protected. Accolade, 550 S. Winchester Blvd., San Jose, CA 95128; (800) 245-7744.

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After Hours

Destiny Knight, The Bards Tale II Adds Eye- Catching Graphics

GAME

by Bill O'Brien

There is nothing more stimulating to an inveterate gamer than challenging software. Terrible games usually find their way to the circular file in a few minutes; bad games may last a half hour. Electronic Arts' *Destiny Knight*, *The Bard's Tale II* might last a lifetime. *Destiny Knight* is part of a new era in PC-based role-playing adventure. This second installment in the *Bard* series adds brilliant graphics to the typical text game format. It also offers an array of opponents that stretches the limits of any sane imagination.

Destiny Knight begins in the tiny town of Tangramayne, one of six cities in a region known only as "the wilderness." You start by assembling your troupe from among a choice of humans, dwarves, hobbits, elves, gnomes, half-elves, and half-orcs. Each member is rated for luck, strength, dexterity, and weapons ability (if you don't like the results, you can "re-roll" for new ratings).

You can choose to make a character a warrior, paladin,

rogue, bard, hunter, monk, conjurer, or magician (sorry, there are no female characters per se, although you're free to name a participant anything). Each of these character types has his own special talents. Bards, for example, are poor fighters, but their songs contain magical qualities that will aid you in your quest.

Magicians and conjurers have similar talents, manifested at different power levels. A magician can gain experience points and advance to conjurer level. From there, the upward path is to sorcerer, wizard, and finally archmage.

No character is without some redeeming value. Even a rogue can be useful when you need to open a treasure chest that might be booby trapped. His special skills (beyond an inordinate ability to skulk in the shadows) include glib fingers that can oftentimes disarm a trap.

The city of Tangramayne is a novice adventurer's paradise. The traps are few, the conflicts mild (in comparison to what will come later), and the experience points accumulate. Electronic Arts has even included a map of the city in the playbook to help you find the healing par-

lors, armament shoppe, guild house, and the all-important tavern (your bard may sing wonderful tunes, but his throat will dry out and he'll lose his voice without a hearty glass of ale every once in a while).

**KEEP YOUR EYES
ON THE PRIZE**

No role-playing game is complete without a goal, and *Destiny Knight* is no exception. In Tangramayne you fight to gain experience and power so that

easier but the mazes (even the less-obvious streets of the various cities) are always difficult.

Destiny Knight is the second installment of the projected *Bard Trilogy*. You may have been disappointed if you played the first episode, *The Bard's Tale*. It was often intractable and not as enjoyable as it might have been.

With *Destiny Knight*, Electronic Arts has taken a quantum leap forward in RPGs. The EGA graphics are outstanding.



In the mysterious world of *Destiny Knight*, wizards are useful companions.

you can face the Dark Maze. Without the optionally available clue book, you'll need to map your way through the seemingly endless corridors as you seek out and rescue a princess. Along the way you'll find clues that will also lead you to a segment of the "Destiny Stone."

Out of Tangramayne, you can go on to Thessalonica, Corinth, or any of the other cities (don't throw away the software

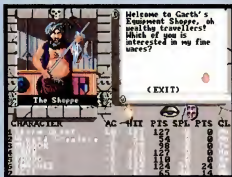
The addition of an all-important "save game" feature lets you retract explorations that have mortal consequences for your players (resurrection is an option at a healing temple, but as characters become more experienced reanimating them becomes more costly).

The manual provides an excellent balance of clues, explanations, and game tips. The cast of villains, drawn from both natural and supernatural realms, is challenging. And if you really don't want to spend time mapping mazes, the clue book will provide the maps for you while remaining cryptic enough to avoid spoiling the game. *Destiny Knight* is well thought out, engrossing, and you will return to it time and again.

List Price: *Destiny Knight, The Bard's Tale II*, \$49.95.

Requires: 512K RAM; CGA, EGA, or Tandy 16 color graphics adapter; DOS 2.11 or later.
Electronic Arts, 1820 Gateway Dr., San Mateo, CA 94404; (415) 571-7171.

As you travel around the city of Tangramayne in *Destiny Knight*, you encounter several "business" establishments.



box; inside the top cover is a map of the wilderness). Fighting Ogres, Giants, Wood Sprites, and worse, you'll explore and recover the remaining segments of the Destiny Stone within other mazes, tombs, and towers. Always map your way. After a while the fighting will become



At the plate, Pete Rose Pennant Fever gives you many of the options that real major leaguers choose from.

At Long Last, PC Baseball That Plays Like the Real Game

GAMES
by Alan Cohen

Since the dawn of the video-game, baseball simulations have traditionally been something of a programmer's nightmare. There are just too many things going on at any one moment: nine men in the field, each independent, and an equally independent batter at the plate.

Baserunners can lead or steal. Pitchers can hurl heat, or curves, or changeups, or go for a pitchout. And so on. Many of these possibilities can occur simultaneously.

No simulation has managed to capture all the little nuances of the sport, and those that came closest often suffered from less than dazzling graphics and sound.

Well, now there's *Pete Rose Pennant Fever* from Gamestar, and players who are willing to put some time into this program will find it to be, if not the definitive baseball simulation, then at least the nearest thing to it. *Pennant Fever*'s got the graphics, the sound (with the help of a digitized voice, the game literally calls the balls and strikes), and the strategy. Short of charging the mound after a knock-down pitch, there's not a whole

lot you can't do in this game that you can do in live-action baseball.

Pennant Fever offers two modes of play. Exhibition Game mode is where most beginners will want to start. Here the action pits one player against a computer-controlled team or two players against each other. In either case, players choose from over 20 available teams, each ballclub (with the exception of the fictitious expansion teams, Eugene and Menlo Park) composed of real stars with real stats. Pitting Doc Gooden against Don Mattingly is as easy as a flick of the joystick.

League Play, however, is where the real excitement begins. In this mode, players take on not only the role of manager, but also of general manager. Choosing either the Eugene or Menlo Park team, armchair Whitey Herzogs are given 10 years (10 "game" years, that is) with which to turn their team of unknowns, draft picks, and free agents into a dynasty of superstars.

The computer takes care of all the math. It compiles statistics, keeps track of the pennant races, and provides status and injury reports on team mem-

bers. All this allows the player to concentrate on the action. Success in *Pennant Fever* won't come easily. The game requires a whole lot of time, effort, and patience to master. Beginners will find it difficult and often frustrating to play (unless they don't particularly mind losing by margins of

63-0 and watching Rafael Santana crunch grand slam after grand slam off the ace of the staff). But perseverance pays off. You may commit 15 errors in a single inning, but you'll be hooked all the same.

Pennant Fever is so hard to play for the same reason that it's

ing option and let the computer do all the work, but really, is that something Pete would do?

There are a number of nice touches built into *Pennant Fever*, such as fatigue factors in league play (a starter has to rest a certain number of games between outings), and a computer-controlled Pete Rose (adds a bit of leadership to a young ballclub). And while you can't position your fielders, you can execute just about any play, including rundowns, pitchouts, and pick-offs.

In fact, the only serious problem with the program is the ineane copy-protection scheme. While the disks themselves are not protected, the player needs to enter a key code from a sheet of un-photocopyable (that is, unreadable) paper before the game will load. Misplace the paper, and you can forget about playing the game. Keep the paper, and you risk going blind trying to read the codes. It is an



Beginners may be tempted to let the PC do the fielding in Pete Rose Pennant Fever. Manual fielding requires skill and practice.

such an exceptional program to begin with: the graphics. Never before has there been a baseball game with such ambitious, life-like animation. In all, there are eight views of the action. Playing the game on an EGA or VGA monitor is almost like watching the real thing on television—you get the same camera angles and the same shots.

Yet with all of these constantly changing views, it takes a special sort of skill to follow the ball in the field. Even experienced players will find it virtually impossible to track a line drive up the middle. Novices can turn on the automatic field-

ing option and let the computer do all the work, but really, is that something Pete would do?

Copy protection aside, *Pete Rose Pennant Fever* is about as good as baseball gets on a PC. It realistically re-creates not only baseball's action, but also its endless details.

■ **List Price:** *Pete Rose Pennant Fever*, \$44.95. **Requires:** 512K RAM; CGA, EGA, or Tandy 16-color graphics adapter; DOS 2.1 or later. Copy protected through documentation. Gamestar, 3885 Bohannon Dr., Menlo Park, CA 94025; (415) 329-0800.

CIRCLE 438 ON READER SERVICE CARD

by
Bill Howard

Abort, Retry, Fail ?

The Lighter Side of Personal Computing



VAPOR WATCH

An occasional report on software and hardware delays. For important products, the vaporware clock begins ticking when the product is announced or becomes public knowledge.

Lotus 1-2-3 3.0. Announced 4/87 with plans for 1988 shipment; twice postponed; now 6/89. Does 3.0 still matter with 1-2-3 2.2 (announced 3/89) looming?

Microsoft Word 5.0. Announced 10/88 with plans for 12/88 shipment. Confident of timely shipment, Microsoft stopped building Version 4.0 and dealers ran out of stock for a month. Also lagging: *Windows Word*, unannounced but common knowledge since fall. Further word: delays cost Bill Gates a one-day paper loss of \$174 million, March 7, 1989.

PM printer drivers. The Presentation Manager shipped on schedule 10/88 (good thing October has 31 days) but with little more than a Proprietary driver. The good stuff (HP LaserJet, PostScript) is delayed till summer. Interim drivers are buggy.

Honorable mention: Compaq SLT-286 docking station, announced with Compaq's new laptop 10/88, may ship 6/89... *SuperCalc 5*, due 9/88, shipped 2/89... Lotus Notes, announced 2/88, due 1989.

"There's no limit to what you can do," boasts this ad for Lotus's *Freelance*. Including run your Model 80 on its side.

Futurists predict that eventually all people will be required to do some personal computing on a regular basis. But not everyone will own a PC. As more homes and apartments come equipped with washers and dryers, we will see the inevitable conversion of laundromats into...

DataMats*

"The Amiga PC" will be the leader in the field, followed by the IBM front-loader, with its controversial spin-cycle architecture.

Wardays will introduce a dot matrix printer that retains its commercial dryer capabilities for shrinking 6 1/4-inch disks to 3 1/4-inch size.

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All DataMats will have vending machines that dispense basic software.

Software

MS-DOS
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IBM PC
IBM XT
IBM AT
IBM PS/2

So That's How Sand Dollars Got Their Name

"An element found in ordinary sand—the semiconductor chip—has created the 'Second Industrial Revolution,' according to the National Academy of Science."

—AP story in the Cleveland Plain Dealer, February 27, 1989

Send entries to *Abort, Retry, Fail?* (formerly *Communications*). Winners get \$50 and a PC

Magazine T-shirt. Please mark the funny part but don't deface an original that we'd photoprint (use a photocopy or Post-it). In case of duplicate entries, award goes to the first or the most legible entry. Winners this issue: Everett Eiselein (*Freelance*), Tony Margevicius (*sand*).

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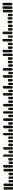


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(November 29, 1988)

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